FACTORY

MANAGEMENT AND MAINTENANCE

MAY 1945

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TO THE AMERICAN PEOPLE:

Your sons, husbands, and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.

We, upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity.

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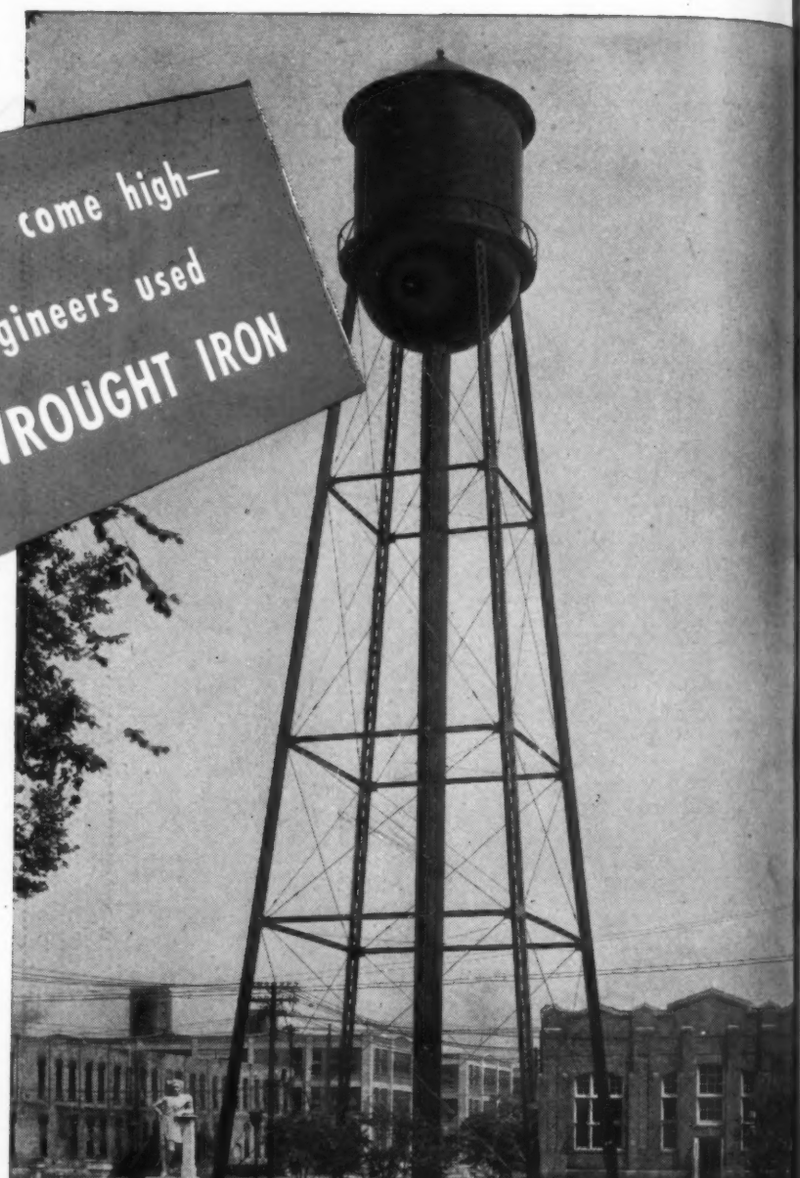
H. H. Arnold

RALPH ILIGAN

Where repairs come high— these engineers used BYERS WROUGHT IRON



When a new elevated water tank was required at the Ohio State Penitentiary at Columbus, State Welfare Department engineers aimed at maximum durability, for repairs come high not only in altitude but in money, in difficulty, and in danger. They specified "wrought iron," and Byers Wrought Iron was used.

The soundness of this choice is confirmed by tanks and standpipes built of wrought iron before the turn of the century, and still serving with no indication that the limit of their usefulness has even been approached. After 31 years of use, the elevated tank in a southern city was dismantled and moved to another locality, where it was still serving at last report, 11 years later. A railroad user reported that one of their tanks, only 200 feet from the seashore, had lasted 51 years, and was still serviceable. A city in Texas has a standpipe in service since 1885, and at last inspection found only slight corrosion at the top, with the scale tightly adherent and no pitting to be found.

These were selected as typical from among a number of equally impressive examples. Your own experience probably includes others.

The reason for these remarkable records becomes plain when the way in which wrought iron resists corrosion is understood. Wrought iron consists of a body of high-purity iron with a multitude of tiny, glass-like fibers of silicate slag threaded through it. When corrosion strikes, it is halted and diffused by the fibers, thus discouraging the pitting and rapid penetration that cause ordinary materials to fail prematurely. The fibers also serve to anchor the initial protective film, that shields the underlying metal just as a scab protects a wound.

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CARBON STEEL TUBULAR PRODUCTS

The cover. Factory cooperates with the Treasury Department, reproduces an urgent message from America's 5-star generals and admirals. Background, *Factory* artist's conception of a War Bond rally.

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FACTORY

MANAGEMENT AND MAINTENANCE

MAY · 1945

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SUSTAINED CONSTRUCTION ACTIVITY

One Step Toward High Level Employment

IN the 34th editorial of this series, it was pointed out that sustained prosperity, based on high level employment, was a major postwar goal accepted by government, management and labor.

That editorial developed the theme that, if the goal were to be approached without undue sacrifice of our essential liberties, we must forego the search for magic panaceas, and follow the harder but more promising course of analyzing step by step, and industry by industry, the measures that might contribute toward the end sought.

This is the first of a number of editorials following such a particularized approach. It will examine the role of the construction industry in forwarding sustained prosperity.

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The influence of construction upon the general level of economic activity is important but not decisive. The claim is frequently advanced that major fluctuations of the business cycle might be ironed out by a properly devised and timed public works program; but any examination of the relatively modest contribution of construction activities to total national output will demonstrate its extravagance.

In the twenty years from 1920 through 1939, the value of new construction averaged just over 8½% of the gross national product. If we add repair and maintenance expenditures, the total is increased to a little over 12% of the gross product. But approximately two thirds of the construction of this period was privately initiated, and only one third was represented by government construction, federal, state and local combined. To expect that we can level out the peaks and valleys of our whole economy through manipulating the 4% portion that is represented by government construction is to expect a very small tail to wag a very large dog.

In fact, the record of construction activity in the past has been on the side of disequilibrium rather than stabilization. In boom times construction activity has climbed to relatively higher peaks than those reached by the economy as a whole; in depression periods it has fallen to deeper troughs. Aside from the special work relief program of the depression thirties, the performance of public construction in this respect is little better than that of private. New government construction mounted with the general trend of the boom from 1921 to 1929, thereby adding its weight to the inflationary trend.

Instead, then, of expecting the construction industry to stabilize our whole economy—a task clearly beyond its power—it would seem appropriate to ask that it look to the more attainable goal of leveling out its own violent fluctuations. If this can be done, many of the most vexing problems of the construction field and of its sphere of influence will be mitigated, employment will be regularized in one important segment of industry where the past record has been particularly uneven, and one aggravating contribution to general business instability will be removed.

The achievement of these highly important, if limited, aims will require the thoughtful, vigorous, and concerted cooperation of management and labor in the construction industry, of a variety of governmental agencies, and of those who direct the sources of construction credit. Of the many measures that must be woven into an ordered program, it is practicable here to present only the broad outline of those which seem to offer the greatest potential usefulness.

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1. Stabilization implies the holding of a balance rather than a freezing at a given level. No rigid formula for a most desirable level of construction activity is possible or desirable. However, it may be accepted as a reasonable initial premise, that we could sustain in the future without major distortion something like the 12% ratio of total construction to gross national product that has been approximated in the past. If it is to serve as an useful reference point, such a generalized premise must be subjected to constant testing both nationally and locally. There must be careful and continuous scrutiny for signs of demand saturation, cost inflation, and labor shortages, all danger signals of far greater reliability than any percentage formula.

The first requisite then is the general availability of information along such lines, far more complete and current than has hitherto been at hand. The second is a general will to hold building activity at a level as high as but not higher than we probably can sustain. Once this principle is accepted, the problem becomes one of marshalling all available instrumentalities to forward it.

2. Public construction, although too small to exert a decisive influence upon economic activity as a whole, can

condition construction trends to a major degree. If, in the decade following the war, government construction approximates its 1920 to 1940 average of one third of all construction, its properly timed impact could do much to level out the construction cycle.

To do this most effectively, public construction should be deferred where and when private building is going forward at a satisfactory pace, and should be started when and where private activity shows undue slack. All government construction does not lend itself to such adjustment. But a large portion of it could be held up for the three to five years which, upon past experience, would provide the necessary leeway to counteract the more violent fluctuations in private building.

Such a program presents numerous difficulties both political and administrative. None should be insurmountable, and the results promise to be of sufficient moment to justify the extraordinary effort that would be required to coordinate federal, state and local government programs. Here is an excellent forum for testing whether or not government economic activity can be made to supplement rather than supplant private effort to serve ends upon which all are agreed.

3. Since private building, postwar as in the past, must supply the preponderant share of construction activity and employment, costs will continue to play a dominant role in determining levels of operation. Wartime restrictions have created formidable backlogs of deferred demand for most types of private, and for many of public, construction. Such demand is so great that it almost certainly will provide the impetus for a postwar building boom of several years duration. There is considerable doubt that in the beginning our building trades, dislocated by war and at low ebb, can organize rapidly enough to carry their share of the anticipated general advance.

However, if former patterns hold, building activity, after a lagging start, will soar, costs will mount, and eventually will saturate effective demand with resultant collapse. That, of course, is precisely the sort of a situation we are seeking to avoid. Crucial to this end is the prevention of rising costs or, better still, the reduction of building costs from present swollen levels.

A recent study by technicians of the War Production Board on the outlook for private housing construction illustrates the point. From 1900 to 1940 the number of housing units built in this country closely matched the statistics of new family formation. The former ran considerably ahead of the latter from 1920 to 1929, and fell behind by the same margin in the following decade.

If the market for new houses were to be similarly limited for the period from 1940 through 1949, the effective demand for new housing during the last five years (1945-1949) is estimated at 3,000,000 units. That is after allowing for houses built from 1940 through 1944, and for vacancies, demolitions, and other factors. If, however, prices could be reduced to 1939 levels, the 3,000,000 unit demand is estimated as increasing to more than 7,000,000 units. Since the latter figure is substantially beyond our production capacity for the period, a backlog would be created that would support an effective sustained demand for the subsequent decade (1950-1959) of 1,000,000 units per year, as against half that amount if rents and sales prices mount with increasing incomes.

The precise accuracy of such an estimate may well be questioned. There can be no question as to the general validity of the point illustrated. The progressive lowering of construction costs will stimulate demand in this field as it has in others. Building management, labor, and their suppliers and customers stand to gain from such a result. Unnecessary restrictions against the adoption of improved technologies and increased productivity should, therefore, be removed, whether imposed by codes of government, regulations of unions, collusion of managements, or inertia of workers. Unless there are compelling social justifications such restrictions must be judged harmful to the whole economy.

4. Numerous other measures could contribute substantially to increased and increasingly stable construction activities. Space remains only to stress the importance of careful consideration for the use of credit facilities as a means of stabilization. In recent years the establishment of the Federal Housing Administration provided a needed stimulus to mortgage lending in the field of housing. The modern pattern of long-term mortgages, providing for regular amortization as well as interest, should be a steadying factor in periods of liquidation. However, there appear to be further possibilities for using credit facilities as a brake when construction activity threatens to climb beyond a level that can be sustained. If public and private lending agencies could devise sound means for raising mortgage rates, increasing down-payment requirements, shortening amortization periods and basing value appraisals upon normal rather than inflated costs, they might exert a healthy influence against the tendency of the construction bubble to inflate until it bursts.

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There is no royal road to sustained high level employment. There is not even a single path to assured construction stability—there are many paths, all strait and narrow and all paved with bruising cobbles. This is true for all other major segments of industry.

It is easier to seize upon a magic formula such as monetary control, or deficit spending, or any one of a score of others, than to undertake an intricate task of piecemeal exploration. But only the latter course will lead to prosperity.

President, McGraw-Hill Publishing Co., Inc.

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FACTORY
MANAGEMENT AND MAINTENANCE
L · C · MORROW · EDITOR

The New President and Industry

Reaction from all over the nation, which has flowed into the metropolitan centers of New York and Washington, leads to the conviction that President Truman and American industry will work well together. It will be imperative that they do so because of the very big and very serious problems ahead, such as these:

1. How far shall industry be permitted to go in reconversion and how soon?
2. What controls over industry shall be carried into the post-war period and for how long?
3. What shall be the government policies as to post-war labor relations and wage structures?
4. How shall tax policies and practices be changed?

Within these questions, which do not represent all the major problems by any means, are bound up such matters as cutbacks, inflation, black marketing, prices, tariffs, international trade, worker migration, housing, unemployment, employer-employee relations, free enterprise. Finding the correct answers is more important when re-entering a peace period than when going into a war period. In the one case industry must sell its goods and services competitively to many customers; in the other, most of the output goes to only one customer, the armed services, and the market is assured.

It is difficult to judge the new President. He has not long been a prominent man. Significant attitudes and actions on his part really began with the series of investigations carried on by the committee of his name. In this work Mr. Truman indicated a genuine appreciation of the place of industry, no bias in the fixing of blame, and the ability to delegate both responsibility and authority.

There is little else to go on except his actions after he became President. Experienced and reliable observers in Washington who, we may be sure, have overlooked nothing of significance, report about like this:

The new President showed a capacity for decision and positive action in making his first official act the announcement that the San Francisco Conference would be held, and in following it by requesting Stalin to send Molotoff as the principal Russian representative. * * * In appointing John W. Snyder as loan administrator of the RFC and DPC he chose an experienced business man. * * * At his press conferences he is straightforward, direct, and in complete command of both himself and the conference. * * * He will seek advice from any qualified source. * * * He will carry out his predecessor's major policies, but with different attitudes and by different methods. * * * He will the more readily reach collective decisions with the Congress and, on the whole, will be responsible for a better climate in which private industry will have more opportunity to serve the national economy.

Here is no long list of glowing achievements, but an encouraging number of favorable probabilities nevertheless. The signs point toward cooperation by industry and President.

L C Morrow

Management Can T

Lines and Headlines From the Labor Press

War Profits 406% Above Peace Rate

Hit Auto Group's Plot to Blacken UAW, Cut Wages

Union-busting Preachers Hired By Ford

UAW-CIO Charges Some Auto Bosses Seek Labor War

If Industry Were As Good As Labor . . .

War Just a Joy-Ride to Some Corporation Big Shots

Chrysler Foments Strikes, UAW Charge

Charge Firm Incites Riots

Talk Back to Labor

CHARLES B. COATES
Associate Editor, *Factory*

ONE OF THE FOREMOST labor relations problems of today is the incessant din of anti-management publicity carried on by labor leaders and editors. This is disruptive. It undermines the labor harmony which collective bargaining is supposed to assure.

How can the worker have any confidence in a labor contract when he is constantly told that one party to the bargain is his enemy? How can there be teamwork between employer and employee when the air is made sulphurous with cries of "labor hater," "union buster," "tory," "stooge," "scab," "smear," "stretch-out," "fascist," and worse?*

Most such stuff is unworthy of reply, of course. Yet much of it undoubtedly finds lodging in the worker's mind. And therein lies a basic cause of the worker militancy, hostility, and fear that make stoppages and slowdowns possible.

Can anything be done about it? Can management "talk back" to labor? Yes, and some managements are proving the value—in the right time, place, and manner—of the specific, factual reply.

The Specific *Versus* the General Reply

This is a subject I have explored recently with scores of outstanding students of industrial and public relations. They agree that management has barely begun to appreciate the importance—or the possibilities—of what, for want of a better term, we shall call "worker education." This is a trifle stilted, to be sure, but that's what the unions call their version of it.

Observers agree, also, that it is usually unwise to dignify a vague, general attack with a direct reply.

When a man asks, "Have you stopped beating your wife?" the only possible reply is to keep your mouth shut and continue to refrain from beating your wife. The facts will then find him out. Suppose, on the other hand, he accuses you of beating your wife with a clawhammer at the corner of Main and Third Streets on Tuesday night at 10:30 o'clock. You've then got a specific lie to spike.

One of the simplest illustrations I have encountered is that of Company A, one of industry's most important units. Like many others, its plants were frequently plagued by wartime "quickies." Most of these were unauthorized, trivial. Yet the union leaders (with reelection in mind) backed them up. Worse still, they aired whatever loose "grievances" and accusations the wildcat strikers happened to supply.

The A management thereupon broke a long rule of silence. Through the daily press, which reaches all its employees, the company issued terse, factual statements of the real circumstances surrounding the walkouts.

Before long the international president called on the company in a conciliatory frame of mind. A frank talk resulted in an agreement which could be summarized thus: "We'll lay off if you will." And since then the whole attitude of the union, even in strikes, has been more moderate.

Some Squirm Under Direct Reproach

Equally simple is the treatment recommended by the industrial relations manager of Company B, a big midwestern outfit.

"If you do nothing else," he says, "you can bawl them out in meeting. For example, I will say to our union leaders: 'Here I was boasting to my top management just yesterday about what reasonable fellows you are. And what happens? Your doggone union newspaper comes out with a lot of stuff calling us all sorts of names. What kind of collective bargaining is that?' They squirm plenty. And I have every reason to believe that it makes them more careful."

Is that labor-hating? Hardly. Company A has conceded the closed shop and check-off. Company B has dealt fairly with scores of unions for years and years. The thing we are talking about takes place within the framework of collective bargaining. It is a wholly legitimate management function—and, some say, obligation.

Technique for Checking a Direct Attack

Consider now the case of Company C and the poisonous gas story. Not long ago, a series of damaging articles appeared in the CIO local newspaper serving the employees of this company's biggest plant. The articles charged that "dangerous and unbearable" gases were jeopardizing lives and health in a certain department.

The articles were, for their purpose, very well done. They were signed by a worker. They contained a nice smattering of scientific information blended with humble indignation. They cited indeterminately "numerous" cases of workers allegedly suffering from a long list of symtoms.

Not content with merely implying neglect on the company's part, the articles went further.

"What does the management propose to do about this?" asked the author. "Exactly nothing! . . . If the company had the health and well-being of the workers at heart it would do something and do it quick."

The company's first step was to write a letter of remonstrance, signed by a top official, to the head of the union. There was no reply. Thereupon the company reprinted its letter

* These are stock expressions from the standard vocabulary of the extensively circulated CIO press. They are rarely to be found in the more moderate and frequently constructive journals of AFL. The United Mine Workers' publications, however, deserve special mention for the unabating virulence of their attacks on management.

NEWS of LOCAL 248
'Gestapo' Board Wages War On Union Representatives
Company Launches New Program of Intimidation To Counteract WLB Union Victory
Local 248 has won Union maintenance from the War Labor Board.
Bulletin:
Fined For Praising Hitler
. . But No Penalty
Allis-Chalmers
UNION CHARGE
COMPANY ANSWER
POP, I'M SURPRISED AT YOU. A SOLDIER GETS COURT-MARTIALED FOR FALLING ASLEEP ON DUTY. YOU ENDANGERED LIVES. SORRY POP, BUT I'VE GOT TO SEND YOU TO THE DISCIPLINE CONTROL BOARD IN THE MORNING.
DISCIPLINE CONTROL BOARD, GOSH I HATE TO FACE THAT BUNCH TOMORROW!
ZZZ
I DIDN'T MEAN TO -HONEST!

In sprightly comic strip, Allis-Chalmers makes specific reply to union charge that disciplinary procedure is "Gestapo." Leading character, "Pop" O'Tool, has many adventures, has become so popular that employee publications of other companies are beginning to take him up

in the monthly newsletter which it regularly sends to employees' homes.

The letter, a masterpiece of brevity and point, is worth study. In the first paragraph it takes cognizance of the "lurid" charges set forth in the union paper's articles. In the second paragraph it quickly polishes off these charges. This is entirely factual, consisting of a report from the state board of health showing that the maximum concentration of the complained-of gases never, under any operating conditions, attains more than 1.2 percent of the safely permissible amount.

Having disposed of the charges thus, the company squares away for an intelligent counter-offensive saying:

"The publication of the false, alarming, and disturbing misinformation referred to . . . has the dangerous potentiality of demoralizing employees, sowing dissension and distrust between employees and management, and interfering with the war effort."

Winners Emphasize Industrial Relations

This case exemplifies a fairly advanced technique. To win at this sort of game a company must obviously have the necessary facilities. For example, the newsletter proved an ideal vehicle—but not every company has a newsletter. And somebody did a bang-up job of writing and research.

Here are some other features of the Company C set-up worthy of remark:

1. Top management lays heavy stress on industrial and public relations. Otherwise there would not have been a newsletter in the first place.

2. The newsletter is used only occasionally as a medium for the refutation of union misstatements. Its first, and much bigger, aim is to give employees information on subjects of interest within and without the company.

3. The newsletter is one of many publications, well-prepared and well-

YOUR CASE IS A HARD ONE TO DECIDE, O'TOOL. ANYONE COULD MAKE THE MISTAKE YOU MADE. THAT'S OFTEN THE TROUBLE IN BREAKING A RULE --YOU DON'T MEAN HARM, BUT HARM COMES ANYWAY. WAIT OUTSIDE O'TOOL--WE'LL TALK IT OVER.
GOSH! I WONDER HOW MY CASE IS MAKING OUT IN THERE?
FALLING ASLEEP ON THE JOB IS A VERY SERIOUS THING. IN THIS CASE IT ALMOST STOPPED CRITICAL PRODUCTION--IT ACTUALLY ENDANGERED THE SAFETY OF OTHER WORKERS
YES, BUT HE DID HAVE TO STAY UP WITH HIS WIFE. IT'S HIS FIRST MISTAKE AND I SUGGEST WE LET HIM CATCH UP ON HIS SLEEP TODAY---A DAY LAYOFF OUGHT TO BE ABOUT RIGHT.
REMEMBER, O'TOOL---WE'VE GOT TO ENFORCE RULES FOR THE PROTECTION OF ALL EMPLOYES. NEXT TIME YOU HAVE TROUBLE, LET US HELP YOU ---THAT'S OUR JOB. GOOD LUCK O'TOOL, AND I HOPE YOUR WIFE IS BETTER.
NEXT DAY
ANY ONE WHO RUNS DOWN THE DISCIPLINE CONTROL BOARD IS NUTS! THEY SURE TREATED ME SQUARE
UH!
HI POP! GEE IT'S GREAT TO HAVE YOU BACK!

... Watch for the Next Pop O'Tool Episode!

edited, by which the management gives the employee a sense of identity with the enterprise. The arts and facilities of the advertising department are called into play as they would be with any other "selling" problem. The industrial relations, public relations, and advertising departments have responsibility and authority to initiate and carry through projects for employee education.

All this would be utterly wasted, of course, had the company proved vulnerable to the union's accusations concerning the gases or to any similar charge. This particular company will not be caught off base in any such way as that. The management is completely sincere, not only in its acceptance of collective bargaining but also in its determination to earn and hold—by deed as well as word—the liking and confidence of employees. It is not too much to say that industrial relations considerations govern top management in every operating decision in which they have any place at all.

Allis-Chalmers Meets "Gestapo" Charge

This brings us to what may well prove to be the historic story of Allis-Chalmers, the "Gestapo" rumor, and "Pop" O'Tool. In all my travels I found nothing to equal it.

The story begins with the installation of the disciplinary control board (described in FACTORY, October, 1943) at the Allis-Chalmers Manufacturing Company of Milwaukee. Without going into detail it may fairly be said that the board's whole objective is to make disciplinary procedure more constructive and that it is based on complete and fair consideration of each case.

But the union didn't like it. And when Local 248 of the United Automobile Workers-CIO doesn't like something, it says so "very loud and clear." Presently the rambunctious local edition of the *CIO News* launched a series of attacks on the control board which is branded a "Gestapo" in one screaming headline after another, declaring:

"A-C Has Opened Its Own Second Front Against the Workers."

Among the least of the adjectives were "dictatorial and terroristic." The

Let's Have the Truth

PUBLISHED SOLELY IN THE INTERESTS OF PROVIDING THOMPSON EMPLOYEES WITH TRUE FACTS

Volume 1, No. 9 — CLEVELAND — Thursday, August 24, 1944

"Mr. Crawford, the Thompson Organization is a Threat to Our Power!"

What are the true organizing objectives of the outside unions which are in the heated race for control of the bargaining relationships of Thompson men and women?

Since they admittedly have nothing to offer in the way of higher wages, better working conditions, greater opportunities at post war jobs, why are these unions now spending huge sums in a second frenzied attempt to organize Thompson employees?

President Fred Crawford revealed today that he had learned the answers to these questions directly from the lips of the highest ranking labor leaders in America.

In addition to his duties as top executive of the Thompson organization, he has also rendered patriotic service as adviser to top men in the national government. He was chosen one of eight American business leaders who comprise President Roosevelt's advisory committee and he has served as an adviser to War Production Chief Donald Nelson and War Manpower Chief Paul McNutt.

It was at a meeting of one of the groups in Washington that Donald Nelson told how strikes and slowdowns were holding back weapons needed by our armies in the field. Mr. Nelson made an eloquent plea for a better understanding between men and management in industry in order to increase fighting war production.

At this meeting, Mr. Crawford spoke at some length on the subject of humanizing labor. Mr. Crawford told how fair forms of top wages, good working ... you find a company which pays ... relations addressing his remarks dealing and man-to-man rela- conditions paid ... highest wages, has the best ... to three of the nation's highest ... tionships had betrayed the lot of numerous other ... ranking AFL and CIO leaders. Thompson men and women. "Why," he ... who were present. ... bringing them success in the leaders, "don't ...

War Output Drops as AFL, CIO Clash

DO THOMPSON WORKERS WA... TO CROSS THIS BRIDGE

KICK IN CHUMS!

OUTSIDE UNIONS

BRASS BOX

GOSH! THEY NEVER USED TO HAFTA DO THIS!

LET'S SEE WHAT MAKES YOU TICK...

Thompson BONUS PLAN

Says CIO

Hardly typical, still "unorganized," Thompson Products nevertheless illustrates advanced techniques in employee information. CIO lost last attempt to bring down Thompson citadel in NLRB election (since set aside). Thompson's F. C. Crawford and aides go all out to combat union attacks

articles referred also to "borrowing the techniques of Hitler" and to "wanton disregard for the nation's security," implying that the company was trying, by such methods, to prevent the union from gallantly winning the war alone.

"The company obviously prefers fighting the union to destroying Hitler," was another sharp comment.

No management would have to be very thin-skinned to resent this kind of attack. But that wasn't the real issue. Such bold, strong stuff is bound to have some immediate effect on the reader—true or untrue. The control board had proved itself a valuable tool in harmonious employee relations, well worth preserving.

Allis-Chalmers's first step was the publication of a booklet entitled "A Word on the Discipline Control Board." An excellent example of simple, natural plain-speaking, it summarized the board's first year of operation. I wish space permitted quotation in full.

Simple Comic Strip Wins Popularity

Meanwhile the control board went on demonstrating its own fairness and efficiency, the best of all possible refutations. Nevertheless, there was a heavy residue of venomous propaganda to be offset. And one treatment will not do the trick.

Then came "Pop" O'Tool, a comic strip character produced by the editors of *We of Allis-Chalmers*, the employee publication. "Pop," a naturally ingratiating old fellow, is an Allis-Chalmers worker who manages to have lots of adventures.

One day, so the story goes, Pop falls asleep on the job. (He had been up all night with his ailing wife.) Then he gets a notice to appear before the control board. He quakes and shudders and has a horrible dream in which the board, fanged, clawed, and wearing horns, deals roughly with him in the manner of Boris Karloff.

Next day, still quaking, Pop faces the board in reality—only to meet with fair and considerate treatment.

Says one of the board members in deliberation:

"Falling asleep on the job is a very serious thing. In this case it almost stopped critical production—it actually endangered the safety of other workers."

Says another board member:

"Yes, but he did have to stay up with his wife. It's his first mistake and I suggest we let him catch up on his sleep today—a day layoff ought to be about right."

Says the board chairman to Pop:

"Remember, O'Tool, we've got to enforce rules for the protection of all employees. Next time you have trouble, let us help you—that's our job. Good luck, O'Tool, and I hope your wife is better."

Says Pop to fellow-workers:

"Anyone who runs down the discipline control board is nuts. They sure treated me square."

This isn't Pop's first adventure, by any means, or his last. He wins bowling championships, helps get out war-winning production ideas. Pop's popularity is spreading beyond Allis-Chalmers and he's being used by publications in other plants. His future is bright, apparently, and his importance as a precedent is already established.

Individual companies must meet their own specific problems, of course. But there's a large area of the management-labor debate which apparently can best be handled on an industry-wide basis. A foremost example of organized talking-back to labor is provided by the Automotive Council for War Production.

An Industry-Wide Retort to Labor

In the recorded testimony of the Council's Managing Director, George Romnen, before the Senate War Investigating (Mead) Committee on March 9, no punches are pulled but fact is piled upon fact. The Council denies emphatically the frequently repeated accusation that it takes an anti-union position. It believes, on the basis of careful surveys, that most workers want to work and will support proper disciplinary controls. It lays the slowdowns, stoppages, and conflicts to minority groups.

The same view was strongly stated before the Mead Committee by H. W. Anderson, vice-president in charge of personnel of General Motors Corporation. He made it clear that he was "not opposing unions as such." Then he, too, sailed into the unions for their frequent abuse of free speech:

"General Motors has become increasingly concerned over the scurrilous attacks being leveled against management and even workers by many official publications of local unions," he said. "Twice, GM has made formal demands upon international officers of the union to incorporate changes in our agreement which would aid in controlling these unwarranted attacks. On both occasions these international officers, who tell us they agree that such attacks are not conducive to good collective bargaining, have promised to take the necessary action. I am sorry to say, however, that despite these assurances, malicious and false accusations continue unabated in intensity."

General Motors Speaks Out on Foremen

Certainly management has a right to demand surcease from this sort of disruption. But since labor leadership will not cooperate, then management itself must go straight to the employee with its own side of the story. Perhaps that's why GM has taken the lead in open opposition to the unionization of foremen.

To this end, GM President Charles E. Wilson addressed a straightforward "Message to Management Employees" on April 2 and at about the same time issued a well-worded newspaper advertisement headed "Should Management Be Unionized?" (Packard Motor, target of the foremen's union organizing drive, followed suit.)

Management's growing awareness of the importance of employee opinion is also displayed by GM in the circulation of a booklet, addressed to foremen and entitled: "What Does the Panel Think? What Does General Motors Think? What Do You Think?" It summarizes: (1) The findings of the National War Labor Board Panel on foremen's unions, and (2) GM policies and practices. Then it gives the foreman a chance to express himself concerning both by checking the answers to certain questions and returning the booklet.

Undoubtedly management has been deterred from the impulse to "talk back" by its recollection of the many restrictive early rulings of the National Labor Relations Board. The ground rules of the Wagner Act, in union organizing situations, have lately been liberalized, however, by the decision of the United States Court of Appeals for the Third Circuit in the case of the Edward G. Budd Manufacturing Company.

The Budd decision rests soundly on the earlier case of NLRB versus American Tube Bending Company, Hartford, Conn. In each instance, the issue revolves around a letter addressed to employees by management on the eve of an NLRB election. The decision provides definition thus:

"Whether the constitutionally protected right of free speech has been abused by an expression of fact or opinion, so as to render the matter actionable as a violation of the Wagner Act, comes down to the question whether the assailed utterances constitute, or are in furtherance of, employer domination, coercion, or interference in his employees' exercise of their legal rights. . . . Admittedly neither the letter nor the enclosure contains any direct threat of loss of employment, discrimination, or any act of intimidation or coercion."

This does not, of course, mean the removal of all restraint. When management gets the impulse to "pop off" suddenly, it will still do well to consult counsel and compare notes with the heads of trade associations and local manufacturers' groups. But there is no real ground, on the other hand, for the almost superstitious silence which some managements maintain in fear of the Wagner Act.

The Amazing Thompson Products Company

For sheer dash and daring in "talking back" to organized labor, the Thompson Products Company, Cleveland, and its mate, Thompson Aircraft Products (Tapco), are out of this world. Were Thompson typical, its story would merit volumes.

Thompson is not typical, however. It is still "unorganized." The CIO lost an NLRB election there last summer after a red-hot organizing campaign the like of which has seldom been seen. Since then, however, NLRB has set the election aside on grounds of interference so the whole business will presumably have to be gone through again.

Thompson has been a doubly shin-

ing target for CIO ever since President Frederick C. Crawford served his term as president of the National Association of Manufacturers. The United Automobile Workers spend more money on Thompson, in fact, than on whole districts elsewhere.

The company can prove, and says so, that incentive-paid Thompson employees have a much better take-home than union and WLB scales. And the management has long used every possible means to win and hold employee confidence. For example, half-hour meetings of all employees on company time have been held with frequency for years. At these sessions top management discusses frankly and in great detail the company's products and prospects. At dinner meetings a management "Board of Experts" takes on questions from the audience.

Executives Take Part in Forums

Those, probably, are the fundamental things that make Thompson such a tough nut for a union to crack. There is, too, an indefinable but important "something" about the company which doubtless traces to the exceptional personality of President Crawford and his staff. No one of them fears to trade punches with anybody in the open. All are available as speakers in the numerous civic forums of Cleveland, engaging union leaders in debate on the same platform.

When the union denounced Crawford as a "fascist," he went straight to the employees and asked how it ever happened that President Roosevelt invited a "fascist" to serve on important government committees. You can't be thin-skinned when a union paper (*The CIO Organizer*) says things like this about you:

"In Painesville, mothers scare their children by threatening to put them to work in Thompson's. When it comes to inhuman treatment and speedup, the devil himself is a sissy."

If you're Thompson Products, you make open and vigorous reply. You publish a series of papers entitled "Let's Have the Truth." You openly lampoon the CIO leaders in cartoons and, what's more, pick out the ex-convicts, drunkards, and communists among them and label them by name.

You nail a pledge of fair treatment and full employment to your masthead. You tell employees how their working conditions compare with those which might exist in union shops.

And when one of your top executives is branded as "Dishonest John" by a union paper, you haul the charge right out into the open, discuss it in your own paper, and disprove it.

But the solid foundation of the Thompson structure, of course, rests on a brilliant integration of industrial and public relations effort and the closest kind of individual contact with employees. This company makes excellent use of bright, ingenious employee publications, annual reports, and economic explanations. For example, Thompson wanted to know what its employees really thought about things, made a survey, and published the findings in "We Led With Our Chins." This led, incidentally, to the discovery that the Thompson bonus plan wasn't fully understood—and hence to the publication of a sprightly little booklet entitled, "Let's See What Makes You Tick."

Curiously, it wasn't Thompson's publications during the organizing campaign to which NLRB objected most. (Nor was their truth questioned.) The board based its Number One complaint on the fact that certain meetings were conducted on company property. At Thompson, of course, there are those who say that NLRB would have set the election aside on one technicality, if it couldn't find another. But it would be interesting to know what the board's findings on the publications would have been had they stood alone as a basis of complaint.

Problem's Measurements and Importance

FACTORY'S surveys ("What the Factory Worker Really Thinks," October and November, 1944) showed clearly that management has a long way to go before it gains, in the employee's mind, what should be its natural position of first leadership.

The conditioning influences considered, there is no particular reason why the average labor leader—or worker, for that matter—should have any natural great liking for management, any more than cats should have a natural liking for dogs.

Unions didn't start that way. I've spent many hours poring over union publications, yearbooks, and histories. The last are especially revealing. Their pattern invariably begins with a recital of the low wages and poor working conditions (often reinforced with trade association or government statistics) in which the unions were born. Then there are the stories of organization and bloodshed. Nearly every union has its martyrs—its Joe Hills and Mackleys, its Haymarket riots and Colorado massacres—whose memory naturally keeps alive the flames of antagonism.

Workers Not "Sold" on Management

The unionization of much of industry is a recent thing. To be charitable, it is probable that many of today's anti-management attacks by labor editors and leaders are a matter of sheer habit—embarrassing as they may be to the saner souls who believe truly in collective bargaining under democratic capitalism. But there are labor leaders enough, God knows—out-and-out revolutionaries — who definitely don't want labor harmony and will continue to do what they can to keep the worker stirred up against management.

Whatever the reason, the average worker is plainly not "sold" on management or the economic system it represents. And this offers a sales problem, a challenge to all the facilities of management.

Does this take time and cost money? Yes, but doesn't the United Automobile Workers-CIO alone spend $219,000 yearly for editorial purposes, $32,000 for research, and $135,000 for education? This isn't all devoted to anti-management, or even pro-union, material, to be sure. But none of it is spent to induce worker confidence in enterprise management, either. And doesn't *CIO News* alone have an estimated circulation of 1,000,000, buttressed by other powerful publications with total circulations that run higher still into the millions?

Perhaps it shouldn't be necessary to consider these things—especially at a time when the top leaders of management and labor are clasping hands over the conference table. But the fact remains that management hasn't gotten the peace it bargained for when it accepted collective bargaining. So the problem is there.

And one approach to a solution may well begin with the realization that management can talk back to labor.

Models Built to Scale Show What Goes Where

MODELS of plants and machinery serve to correlate not only the technical ideas and designs of the engineer and the purchaser, but also the ideas of various functional groups of the organization commissioned to erect the structure.

A scale model presents a three-dimensional picture which stimulates the imagination, creates interest, and materially aids the designs prepared by various engineering groups.

When, in addition, a model is made of transparent materials, its usefulness is enhanced.

All these facts were taken into consideration by Blaw-Knox Company, Pittsburgh, when asked to design and construct five synthetic rubber pilot plants for five different operating companies. Blaw-Knox had previous experience with models, and had found them useful to illustrate the operation of concrete spreaders, open hearth furnace doors, and other products.

Models, Blaw-Knox has found, enable both engineer and purchaser to see and make necessary basic decisions regarding plant expansion, layout improvement, centralization of controls, building and safety requirements, isolation of possible hazards, and inspection of equipment layout from the standpoint of operational flow. Decisions regarding divisions of work and plot limit lines may also be conveniently made with a model.

Construction and operating departments find models of value. The former can obtain an accurate visualization of the plant being built, while the latter can use the model to establish operating procedures and the training of personnel.

Since the essential purpose of the pilot plants was for experimentation with various processes and apparatus, changing the technique from time to time, it was important that the equipment should be arranged in such a manner that it possessed maximum flexibility at minimum cost.

All equipment was made to ½-in. scale. The transparent material (methyl methacrylate) used for floors, roof, and walls, was ¼ inch thick. Process equipment was prepared from wood, and considerable detail was given to its fabrication. Each floor was removable. All equipment was detachable, so that new arrangements of the equipment could be studied.

A definite saving in time and money was assured. Layout of the plant was improved. By being able to see exact location of equipment, interest in the plant was increased for such departments as procurement, expediting, and accounting—departments that rarely obtain full visualization of the projects on which they work.

The model permitted the piping draftsmen to arrange the piping so that unnecessary loops were avoided. Equipment could be connected in the most direct way. The model also assisted the vessel designers and structural engineers to arrange suitable supports for equipment and building without disturbing the functional operation of the plant.

Scale model of synthetic rubber pilot plant enables accurate visualization of the structure before it is built, thus facilitating basic decisions regarding plant expansion, layout improvement, and so on

Work-in-Process Control Increases Efficiency

EUGENE M. LANG, Director of Planning and Production, Aircraft Screw Products Company, Inc., Long Island City, N. Y.

ADEQUATE CONTROL of physical work-in-process is one of the more critical phases of sound industrial management. Where such control is deficient or neglected, it quickly becomes reflected in delinquent deliveries, excessive proportion of scrap, lost machine time and man-hours, poor quality control, unsatisfactory or widely varying employee output performances.

Many months ago, Aircraft Screw Products Company, Inc., Long Island City, N. Y., a relatively small company, initiated a simple system of work-in-process control. It was developed with the following specific objectives in view:

1. More accurate accounting for work-in-process to assure that parts in production do not go astray or become irresponsibly scrapped or side-tracked.

2. Greatest possible accuracy in maintaining records relating to production costs, machine output, employee production efficiency.

3. More adequate control over bad or careless workmanship through ability to assess responsibility for same.

4. Reduction in the number of non-productive man-hours and machine-hours by provision of a basis upon which work-in-process can be expeditiously handled and followed up.

5. Proper coordination of parts traveling different production routes to final product assembly.

6. Prompt and reliable information as to the status of work-in-process and the transmitting of such information to the supervisory personnel who are directly concerned.

ROUTE SHEET

Route Order No. 12446

Sub Order No.

Name of Item Gages - Thread Plug Part No. A188-6 B. P. No. A188-6-C

Description 3/8-16 Heli-Coil QUANTITY In Production 100 Finished O. K.

Type of Order Sales ☑ Stock ☐ Equipment ☐ Tools ☐ Development ☐ Maintenance ☐ Misc. ☐

Date Delivered to Shop 3/1/45 Date Promised 3/25/45 Finished

Oper'n No.	Operations	Dep't	Inspd. O. K.	Machine	Tools	Set-Up Minutes	Minutes Per Piece
9	S. U. Band Saw Cut off	3		Band Saw	—	20.-	.20
10	Cut Blks - 1.395-1.385	3		" "	—		.25
19	S.U. - Face, C. D.	7		Bench Lathe	C.O. Ref. T.P., dg	25.-	.25
20	Face, C. D.	19		X L O	"		.40
179	S. U. - Etch	14		Elec. Etcher	—	20.-	.20
180	Mark per B/P	14		" "	—		1.25
190	Final Inspection	23		—	I. B. P.		

Material 7/16 rd. XYZ O.H.T.S

R. N. 11055

E. M. Lang
Authorization

Figure 1. First of the six forms needed to operate work-in-process control system at Aircraft Screw Products Company, Inc., is the route sheet or work order; prepared in triplicate, it specifies item to be produced, raw materials requirements, and detailed sequence of manufacturing operations

Output of this company covers literally hundreds of specific items and sizes. At all times, there are approximately 200 different work orders in process. Of these, at least one-half are manufactured for assembly into a finished product.

The quantity of parts processed on each work order ranges from 6 pieces to more than 50,000 pieces. Most work orders, however, call for about 500 units. Moreover, the average work order must travel through at least 12 operations, usually about 20, and often, more than 50.

Six Forms Required

The operation of the work-in-process control system is tied in with a series of forms, each designed to accomplish specific purposes:

1. *Route Sheet* (Figure 1). Prepared in triplicate in the production department, route sheet (or work order) specifies the item to be manufactured, quantity, raw materials requirements, and the detailed sequence of manufacturing operations. These forms are numbered serially.

2. *Material Requisition* (Figure 2). Prepared in duplicate for each route order, in the production department, it specifies the materials to be released against the route order to which it applies. These forms are numbered serially.

3. *Production Card* (Figure 3). Prepared daily by each employee, gives in detail the work done—time spent, on which machine, performing such and such operation, on so many pieces, against which route order.

4. *Dispatcher's Record* (Figure 4). Prepared in duplicate by the dispatching department, for each route order, as soon as manufacturing is initiated, gives an up-to-the-minute record of all work-in-process under each route order.

5. *Daily Machine Activity Report* (Figure 5). Prepared in triplicate at the end of each shift by the dispatching department, specifies the route order and operation assigned to each machine in the factory. Also specifies number of parts at the machine for processing at the beginning of the shift, number of pieces processed during the shift, and number of pieces remaining to be machined.

6. *Production Inquiry* (Figure 6). Prepared in the statistical department to bring inadequate production of any employee to the attention of his foreman and to secure from the latter an explanation.

MATERIAL REQUISITION No. 11055

A188-6 (Part Number or Blueprint Number) | 12446 (Order Number or Account Number) | 2/14/45 (Date)

Stock Number

Wt.	Quantity	Unit	Size or Part No.	Description	Unit Cost	Amount	
7/8	13¼	ft.	7/16 rd.	XYZ O.H.T.S.	.38	2	705
Account Credit: C.S.				Date of Issue: 3/1/45		Total	2 705
Signed by: A. A. Jones				Approved by M. Smith			
Entered—Stock Record: 3/1/45 T.C.				Entered—Cost Record: 3/7/45 L.P.			

Use separate Requisition for each order or Account Number

Figure 2. Material requisition, prepared in duplicate, specifies the materials to be released against the route order to which it applies

The initial steps, to the point where work-in-process as such becomes the focal point of control, are enumerated as follows:

1. The production department prepares the route order form in triplicate, and the material requisition covering the route order in duplicate. One copy of each is immediately transmitted to the cost department. The "cost" copy of the route order, appropriately printed as a ledger sheet on its reverse side, is inserted into the cost ledger. All direct costs applying to the route order—including raw materials costs specified by the materials requisition form—are posted to this copy.

2. About 10 days before work on a route order is scheduled to start, the two remaining copies of the route order and the copy of the material requisition are placed in a cellophane jacket with the proper blueprint, and transmitted to the foreman in whose department processing of the part in question is to be initiated.

3. The foreman examines the route order and blueprint in detail and checks on the availability of minor tooling or other requirements.

4. The foreman turns over to the dispatching department one copy of the route order, together with the material requisition form. At the same time, he indicates to dispatching approximately when work will begin on the route order. The foreman retains his copy of the route order (the "shop copy") and the blueprint.

5. The dispatching department delivers the material requisition form to the raw materials stockroom, and obtains requirements specified.

6. Dispatching holds the materials for delivery to the machine indicated on the "operations specifications" of his copy of the route order. Delivery is made to the machine about one hour before work is to commence.

7. When the machine is cleared by the completion of a previous job, the machine operator clocks out on his production card and reports to the foreman, who gives him the shop copy of the route order and the blueprint.

8. The machine operator, assisted or unassisted, sets his machine for the operation. He clocks in and out on his production card for set-up time, as distinct from production time (see Figure 3).

9. At the end of each shift, the dispatching department collects all parts from the machine on which assigned operations have been completed. These parts are physically counted (individually or by weight depending on type of part). Totals are checked against the amounts indicated by the machine operator on his card.

By removing completed work from each machine at the end of every shift (or during the shift if the operation has been completed on all parts) work done on one shift is not confused with the output of a succeeding shift. This, together with the check on production count, enables more precise

TIME REPORT

1:05 — Rate

411 — Clock No.

John Doe 4026-78-0275 — Name

Monday, Feb. 19, 1945 — Date

Stamp

Time Clock Record	Elapsed Time			Amount		Route Order No.	Operation No.	Part or Blueprint No.	Mach. No.	Quantity Good	Quantity Rejects
FEB 20 0 .0		7	Off		13½	17582	10	531	84	9	
FEB 19 23 .3			On								
FEB 19 23 .3		3	Off		3½	17582	11	531	84		
FEB 19 23 .0			On								
FEB 19 23 .0	3	5	Off	3	67½	17582	10	531	84	45	
FEB 19 19 .0			On								
FEB 19 19 .0	1	7	Off	1	78½	17582	9	531	84		
FEB 19 17 .3			On								
FEB 19 17 .3	1	3	Off	1	36½	16753	20	622-50	84	32	
FEB 19 16 .0			On								
	7	½		7	87½						

2/20 RP — Posted—Payroll Book

2/22 gk — Posted—Route Order

2/23 as — Posted—Operations Comparison

2/20 Le — Posted—Production Record

Foreman's O. K.

Figure 3. Time report or production card, prepared daily by each employee, records the work done, time spent, machine worked on, and operation performed. Note that elapsed time from 19.0 to 23.0 is set down as 3½ hours—explained by the fact that the 30-min. lunch period has been subtracted

quality control and the preparation of more accurate production and cost records.

Where step 9 applies to parts on which the initial manufacturing operation has been completed, the second general phase of the system becomes active. Raw materials having been converted into work-in-process, elements of control become necessary. Here the dispatching department carries the primary responsibility and becomes involved in the following sequence of activities:

10. At the time that dispatching follows through on step 5, it prepares the dispatcher's record from (Figure 4) in duplicate. This form is little more than a ledger account applying to parts in process on each route order. The initial entry, or entries, on this form develop from work-in-process collected after the first operation has been completed. The total number of parts, checked in after the first operation, must be accounted for throughout the manufacturing cycle.

Simultaneously with the preparation of the dispatcher's record forms, definite rack or bin space in the dispatching department is assigned to the part to be processed. The forms, together with the dispatcher's copy of the route order, are placed in a cellophane jacket which is tacked up over the bin or rack.

Parts are moved from one operation to the dispatcher and on to the next operation either by truck or by hand carrying, depending on the size of the unit and the weight involved. Delay in movement of completed parts is eliminated, whether during or at the end of a shift, by the fact that an employee, when he either completes work at the end of his shift or completes a particular job during the shift, is required to bring his production card to the dispatcher for punching. As soon as the dispatcher receives this production card, he must collect the completed parts, check the count, and route the completed work as specified on the order.

Where parts are ready to be issued from dispatching for the second or any subsequent operations, entry is made on the appropriate dispatcher's record form indicating the quantity issued, date and time, the operation, and the specific place where it is to be performed. The person in charge of the "place"—either a particular machine, a department, or an outside processor—is responsible for the number of semi-processed parts delivered by dispatching.

11. At the end of each shift, or during the shift, dispatching collects parts from all machines or departments, as per step 9 above. Incompleted parts, which are to be followed up on the succeeding shift, are left at the machine. However, they are physically counted. The number of parts completed and removed, plus the number of parts left at the machine, must tally with the total number of parts originally delivered to the machine or recorded as left at the machine at the end of the previous shift.

Discrepancies must be accounted for. When the system was first introduced, there were frequent minor discrepancies. In many cases, these were resolved by examining the contents of scrap bins or refuse cans where employees had disposed of faulty pro-

DISPATCHER'S RECORD

Route Order No. 12001 Part No. 227-50 Quantity 300 Sheet No. 1

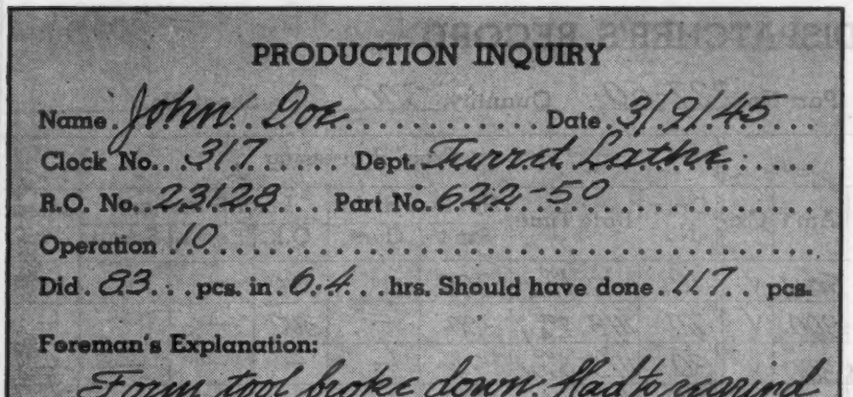
To Processing							From Processing							
Date	Time	Oper. No.	Dept. No.	Machine	Am't	Ck.	Oper. No.	Date Time	No. Pcs. Ret'd Am't	No. Pcs. Ret'd Cum.	Insp. Summary O.K.	Insp. Summary Rewk.	Insp. Summary Scrap	Misc. Pcs.
11/2	8:00 AM	10	3	#31 Saw	Steel	V	10	11/2 1:00 PM	300	—	300	—	—	—
11/2	5:00 PM	20	7	#35 Lathe	300	V	20	11/3 2:00 AM	300	—	300	—	—	—
11/3	12:30 PM	30	1	#4 Drill Press	300	V	30	11/3 6:00 PM	94	—	—	—	—	—
							30	11/4 4:00 PM	147	241	—	—	—	—
							30	11/4 11:40 PM	59	300	—	—	—	—
11/3	6:00 PM	40	20	Insp.	94	V	40	11/3 11:30 PM	94		94	—	—	—
11/4	8:10 AM	40	20	Insp.	147	V	40	11/4 2:00 PM	147		146	1	—	—
11/4	12:30 PM	40	20	Insp.	300	V	40	11/4 5:15 PM	59		59	—	—	—
11/7	8:00 AM	70	20	Insp.	122	V	70	11/7 2:05 AM	122	—	121	—	1	—
11/7	4:00 PM	70	20	Insp.	84	V	70	11/7 8:20 PM	84	206	82	2	—	—
11/8	8:10 AM	70	20	Insp.	94	V	70	11/8 3:15 PM	94	300	94	—	—	—
11/9	12:30 PM	80	24	Burr	299	V	80	11/9 6:00 PM	264	—	—	—	—	—
								11/10 10:20 AM	35	299	—	—	—	—

DAILY MACHINE ACTIVITY REPORT

Date 3/9/45 Day V Night

Dept.	Machine	Operator	R. O. No.	Part No.	Oper. No.	No. Pcs. at Mach. begin. Shift	Activity Summary No. Pcs. Done	Activity Summary No. Pcs. Left	Activity Summary Total Acc. For	No. Pcs. Miss.	Notes
1	#1 Drill Press	317	11518	37450	40	179	145	34	179	—	incl. 1 scrap
1	#2 Drill Press	302	12366	AT-4-6	60	1540	618	922	1540	—	
1	#3 Drill Press	idle									
1	#4 Drill Press	290	12184	277-40	30	278	63	215	278	—	
1	#5 Drill Press	341	10983	521	30	312	188	123	311	1	looking for pcs.
1	#11 Broacher	idle									
1	#12 Broacher	288	11933	601	80	400	191	209	400	—	
1	#15 Am.	215	12401	611	110	92	92	—	92	—	
6	#61 Miller	114	10928	527	60	115	105	10	115	—	
6	#62 Miller	273	11444	195-3	40	244	233	11	244		
6	#63 Miller	279	12359	B304							

Figure 4. Dispatcher's record is prepared for each route order, provides up-to-the-minute data on all work in process . . . Figure 5. Daily machine activity report specifies route order and operation assigned to each machine, shows pieces at machine at start of shift, pieces done, pieces left



PRODUCTION INQUIRY

Name John Doe ..... Date 3/9/45

Clock No. 317 ..... Dept. Turret Lathes

R.O. No. 23128 ... Part No. 622-50

Operation 10

Did 83 ... pcs. in 6.4 ... hrs. Should have done 117 ... pcs.

Foreman's Explanation:

Form tool broke down. Had to regrind.
Failed to punch Prod. Cd. properly.
RL 3/10

Figure 6. Production inquiry is used to bring cases of inadequate production to foreman's attention and to secure an explanation

duction. One result of a hard-boiled check-up at the end of each shift has been the elimination of this practice and a higher quality of production.

12. Parts collected by dispatching from machines are credited against quantities originally issued to machines as specified on the dispatcher's record forms. However, the quantity of such parts left at the machine is recorded. First, the count is written on a small card which is left at the machine with the parts. This indicates to the operator the quantity to be accounted for at the end of his shift. Second, the same count is recorded on the daily machine activity report (see Figure 5).

13. The daily machine activity report is prepared in triplicate by dispatching at the end of each shift. This form is essentially an inventory of all work-in-process. Every machine engaged in production at the end of the shift is listed. The work each is doing is properly identified. A special column states the number of parts left at the machine for processing. Totals in this column must be balanced on the succeeding report.

One copy of the daily machine activity report is given to the general foreman of the succeeding shift and one to the production manager. In this way, both are informed as to "What's going on in the factory." The third copy is retained by dispatching to serve as a basis for its next report.

In connection with work-in-process control, plant layout plays an important part. The dispatching department is centrally located to permit most convenient access to all machines. Time clocks on which employees' production cards are punched are located in dispatching. No employee is permitted to punch his own card. It must be done by an attendant in dispatching so that all information stated by the employee on his card can be promptly checked.

Likewise, the inspection department is located contiguous to dispatching. In this way, work-in-process, as collected, can be promptly sent through for process inspection. Scrap pieces, or parts to be reworked, are sorted out in inspection, so that responsibility for poor workmanship may be assessed without delay.

Permanent History

The utility of records prepared goes beyond work-in-process control itself. When a route order is completed, one copy of the dispatcher's record form is stapled to the shop copy of the route order for filing in the production department as a permanent history of the parts processed.

Similarly, the duplicate copy of the dispatcher's record is stapled to the dispatcher's copy of the route order. These forms are transmitted to the statistical department, where they are examined for accuracy. Scrap and rework listings are noted, and entries are made on employees' personnel cards for faulty workmanship. Production difficulties, as reflected in scrap or rework on particular operations, are brought to the attention of the production and engineering departments for consideration.

Production cards of employees are indispensable in maintaining cost records and production control. Each morning, all production cards of the previous day are forwarded to the statistical department. Each card is quickly examined and those indicating unsatisfactory production are segregated. For each of them, a production inquiry form (Figure 6) is immediately filled out. This form indicates the unsatisfactory performance and specifies the required standard of production. The form is transmitted to the foreman of the employee concerned. The foreman must explain the poor showing. If there is no satisfactory explanation—such as machine breakdown, broken tooling, etc.—the foreman notes "bad production" on the form, which is then returned to the statistical department, where proper entry is made on the employee's personnel record.

From the statistical department, production cards are sent to the cost department. Man-hours spent by each employee are costed at his wage rate. Both figures are posted to the cost sheet of the route order involved.

After the cost department has completed posting, production cards are sent back to the statistical department. Here each card is analyzed in terms of units of production per operation per man-hour. These figures are posted to a production summary form which is prepared each month. These summaries reflect the composition of direct costs, provide a basis for more satisfactory cost control, and tie in with the merit system of granting wage adjustments.

Although a considerable investment in time, money, and personnel has been made in keeping the system of work-in-process control operative, the following facts show it to be sound:

1. The ratio of this company's overhead costs to direct production costs has fallen by 25 percent.

2. Delivery promises to customers have been met or bettered more than 95 percent of the time.

3. Customer rejections have dropped to less than ¼ of 1 percent of the value of materials shipped.

4. The proportion of scrap has fallen to less than 2 percent of the value of all the work that is initiated in the factory.

5. The ratio of dollars of material shipped per man-hour worked has increased by more than 70 percent during the past year alone.

Post-War Fears of Management and Men

WHITING WILLIAMS, Consulting Editor, *Factory*

EVEN A BLIND MAN can see the heap of headaches which V-E Day will unload into the lap of management. All he needs is a lively appreciation of the troublous potentialities of uncertainty and fear—*practically universal uncertainty and fear.*

"Today, millions of wage earners," so a labor leader puts it, "fear victory, peace, and the possibility of unemployment vastly more than they ever dreamed of fearing the Nazis or the Japs!"

Too true of hourly workers to merit argument or elaboration, the same holds for many salaried foremen—especially if to "the possibility of unemployment" you add that of demotion. It was these two, plus the fear of discharge on the complaint of union stewards and without appeal, which at Ford's caused the first and largest chapter of the Foremen's Association of America.

What the Unions Fear

Likewise, a huge number of union heads now fear for the post-war security of their organizations. Even those who have managed to keep their no-strike pledge have now to worry about the continuance of dues, and hence their salaries, because the moment victory releases them from that wartime promise they must start worrying about the retention of membership maintenance, established as this was by government in return for that pledge. Besides current legislative attacks on the closed shop in several states, many of these leaders now fear the peacetime possibilities of other state and federal restrictive laws.

In addition to having given a big push toward the PAC-CIO, this bundle of worries accounts for the recent demands for higher hourly rates with which to offset the expected shorter work weeks, for longer vacations, generous dismissal pay, sick leave pay, paid insurance, veterans' funds, elimination of geographical wage differentials, and for seniority as the chief basis of promotion. Similarly aimed at a shock-proof unionism are, of course, the strenuous campaigns for enrolling foremen and office workers, for more power in management, and for a larger part in both domestic and world-wide politics and government.

It is worth noting that all these drives differ considerably among the various organizations — and differ largely because of difference in the intensity of their post-war fears.

Thus most AFL leaders expect fewer organizational jolts from V-E Day than do their CIO competitors. Because these latter have always had so much faith in the sales appeal of "ten cents more per hour," they are widely considered to have done a "lousy" job of building loyalty to the labor movement as an ideal worth devoted defense through thick and thin, in good times and bad. As soon, therefore, as prospects fade for that ten cents (or for bigger "take-home"), their memberships and dues, so say their competitors, can be expected to fall off seriously—at just the time, furthermore, when maintenance of membership (perhaps also union and closed shop) would be in jeopardy.

Still further, among the smaller, so-called independent, unions led by Matt Smith, these fears of the great transition can almost be said to be transmuted into *hope*—hope that, once the wage elevator breaks down, multitudes of members in the biggest (CIO) unions will perceive that their officers have become too highly paid, too autocratic, too insulated and remote, too busy with their hectic internal power intrigues, and too absorbed with national and international politics to bother with the boresome gripes and "beefs" of their rank-and-file duespayers.

Precisely this same hope or belief that big and allegedly unsold unionism will be easy picking is evidently shared by one John Lewis. His recent demand that coal be henceforth withheld from "consumers whose employees are engaged in a legal strike" could certainly be made a mighty tool for widespread raiding.

It is bad enough that this combination of interunion fears and hopes has persuaded many leaders to threaten withdrawal from the federal labor boards at the same time that great numbers of their highly irritated members insist upon "wild-catting" against the same boards' endless delays. The situation is, of course, made still worse by the almost complete agreement with which many leaders—in spite of the recent Johnston-Green-Murray pact—tell their members that profit-stuffed Big Industry now plots nothing less than the repeal of the Wagner Act and the complete destruction of unionism!

Altogether, now that collective bargaining has largely given way to political finagling, no expert crystal-gazer is required for requisitioning an abundance of cold towels for the troubled brow of post-victory management. Certainly if all this conglomeration of worker fears and hopes is to be stirred by the sharp stick of temporary and spotty unemployment, the results look like a very unpleasant mess.

Intraunion Battles

To the current uncertainty, pending court decision, as to whether Selective Service demands the virtual destruction of seniority for the benefit of the returning veterans, will be added the touchy difficulties of race and race discrimination in the matter of layoffs. Along with the probable intensification of the never-ending battle for closed shop is likely to come fresh outbreak, in some unions, of the quarrels for control between entrenched officialdom and rank-and-file, and, in others, between the pro-Americans and the pro-Russians, this last a power struggle only partially damped down while both fought Hitler, and likely to flare up as soon as these two nations are no longer front-line allies. These intraunion battles, needless to say, will hardly cool the prospective sizzling brew of slowdowns, "quickies," legitimate and illegitimate strikes, jurisdictional tie-ups, and interunion raids.

Bad as all this is, the manager might still offset his own fears of it with the hope that when, if, and as he

How the Manager Can Allay Workers' Fears

1. He can devote himself, now, to allaying his workers' fears by discussing his (and their) problems with them, to convince them that his own concern over the ugly possibilities of post-war shutdown is as serious as theirs—and, now that unemployment insurance protects all from hunger, for much the same reasons.

2. He can prepare, now, to give full, candid, and above all *immediate* explanation of whatever temporary or other layoffs may be required by his own plant's cutbacks, cancellations, and other reconversion difficulties. (It will be a tragedy if big, multi-unit industry proves itself too slow and unwieldy to show either the frankness or the speed demanded for the quick lessening of its workers' worries.)

3. He can also allay the fears of his workers' *leaders* by assuring — and convincing — them that he desires, not the abolition of unions, but only their willingness voluntarily to respect his responsibilities as fully, and generally to play as fairly by him, as government compels him to respect theirs and to play by them.

4. He further can make sure, now, that the fears of his immediate subordinates and his foremen are lessened by a better-than-ever understanding of company policies, programs, and procedures, and of their individual responsibilities, authorities, and privileges with respect to them.

5. He can build hope for a plentiful of post-war orders by keeping his costs and prices down through utmost use of simple incentive systems. (Post-war wages will deserve the name of "too high" only if they fail to represent proportionately high individual output.)

6. He can restore worker pride and the incentive of hope for advancement by resisting anew the recent efforts of government and others to destroy legitimate differentials for blue-shirt skill and white-collar responsibility. (It is a grim joke that Russia has learned by experience to increase these lures and rewards at the very time that we have been eliminating them.)

7. He can also re-vitalize worker pride and ambition by using ratings and other yardsticks as the chief basis of promotions. (The current pressures for upgrading by seniority alone do not mean that workers have lost all hope of advancement via merit. It does mean that, as between service term and the boss's whim or favoritism, they consider service term the lesser of two evils. They are as interested as ever in the internationally unique American institution called the job ladder. But they want to know more about the nature and location of its rungs.)

8. Finally, he can lean strongly upon the continuance of those prides of company and of individual job accomplishment which have never been so evidenced or so recognized as during these war years. For during these years, all of us have, as never before, measured our right to believe in our individual selves by the consciousness of our individual and company contribution to victory.

is again free to bargain with his own fellow-workers across the table, he can come to effective understanding with them. Unfortunately, it has to be added that, rightly or wrongly, he has felt justified in harboring a different and additional fear. This has been the fear that his best efforts to keep his wheels a-turning peacefully would be stymied by a government which had been unable or unwilling to adopt any impartial and constructive labor policy, and which offered little assurance of giving him and his efforts a fair break —of showing proper patience before it would call "Time! You've had your chance at the 60,000,000 jobs we promised. Now it's our turn!"

Whether the observer has good eyes, bad eyes, or no eyes at all, what else can be perceived than, alike among workers, leaders, and managers, "practically universal uncertainty and fear"?

What can the manager do about it? First and most important, he can get consolation by reminding himself that the big boss of the whole current labor situation is not industry, not unionism, not government, but public opinion. Regarding the other three, this big boss has learned a lot by observance of their performance during the country's recent and greatest crisis. Already in many ways it is now showing renewed and more courageous willingness to "accentuate the positive, eliminate the negative," and favor a fairer break for all the various in-betweens. Above all, this boss stands ready to approve any and every effort, by whomever made, toward lessening that "practically universal uncertainty and fear."

The manager can, accordingly, expect enthusiastic approval if he considers such steps as the eight above.

What all of us who together comprise boss public opinion are learning is this—that much, perhaps most, of the troublesome idiosyncrasies of current worker behavior are to be blamed upon the war and its brood of post-war fears. Small wonder if this evil brood fathers a huge tribe of post-war perplexities and pains. But, in tackling these, it is worth noting that from this same war, and the way our boys have won it, we have also learned more than we ever knew before about the *nobility* of our common American human nature. Furthermore, from top to bottom of our American public, we have all of us learned about that nobility together.

So thank God for victory—and bring along its heap of headaches! American managers, men, and leaders, helped by the American public, have what it takes to handle them—and handle them *together!*

WHAT VICTORY IN EUROPE MEANS TO INDUSTRY

Importance of Vinson announcement lies in pattern of policy revealed. Nothing sudden and nothing big expected in civilian goods production during new phase of all-out war against still-strong Japan. "Little fellows" to get best break in scramble for scarce materials, but 72 selected industries can begin to "tool up" now

SWIFTLY FOLLOWING V-E DAY came the announcement of national policy which set up the signposts for industry to follow on the road which will lead eventually to reconversion. Washington decreed:

1. Until further notice, top priority for production for the Japanese war.

2. In the next 6 months, gradual cutbacks of 10 to 15 percent in over-all munitions production.

3. In the second 6 months, heavier cutbacks amounting to about 33 percent of present war production.

4. Some temporary unemployment, probably not exceeding 2,500,000 at any one time within the year.

5. Gradual reconversion, gradual relaxation of government controls, gradual use of WPB "spot" authorizations for civilian goods production, and gradual release of material to the free market by "open-ending" the unallocated portions of steel, copper, and aluminum now circumscribed by the Controlled Materials Plan.

6. Manufacture of a "few" automobiles in 6 to 9 months and a "moderate" number of household appliances somewhat sooner.

7. Redeployment of the armed forces for all-out war against a still strong Japan and demobilization of about one soldier in four on a service-point basis.

Two days after Germany's surrender, War Mobilizer Fred M. Vinson unrolled the blueprint for "Phase Two" of the war. Within the week a cloud of more specific announcements arose from the various government agencies which will have a part in reconversion.

It quickly became clear that the real significance of the post-V-E Day announcements lay in the character of the policy they revealed rather than in the weight of their immediate economic effect. The announced probable volume of cutbacks for the coming year will amount to about $14,500,000,000, hardly more than 6 percent of the total national income for the same period.

This means that, unless fundamental changes are made in the blueprint itself, there will be nothing sudden and nothing really big about reconversion, especially in the next 6 months.

Manpower

A SURPRISINGLY LARGE number of people will be shaken up occupationally by the combined processes of industrial and military redeployment, however, Vinson predicted that 1,500,000 workers will be temporarily unemployed in the next 6 months and 3,000,000 more in the 6 months following. Add to these the normal 1,000,000 of irreducible "turnover" unemployment, some 2,000,-

000 returning servicemen, and an additional 700,000 still leaving civilian life for the armed services, and you get a very fluid manpower picture.

War Manpower Commission field directors already have their orders: To use existing controls to make sure that needed munitions requirements are met and thereafter to relax these controls wherever it is desirable for the purpose of keeping people employed. Over-all, Vinson predicts, there will probably be only 2,500,000 unemployed at the end of the year.

Cutbacks

THE ANNOUNCED CHARACTER of projected cutbacks is principally of significance to the metal trades. The Navy program will steam ahead for the present, virtually unchanged. The Army, on the other hand, expects to knock out about $3,500,000,000 in contracts within 3 months. The bulk of the cuts will fall in the ordnance field—240-mm. howitzers, 8-in. guns, 155-mm. howitzers; artillery ammunition for 4.5 guns, 8-in. guns, and 240-mm. howitzers; light, medium, and heavy trucks; light tanks; armored cars; 105-mm. tank destroyers; Garand rifles; automatic pistols; and 50-caliber machine guns.

At the same time, production will be stepped up on large-caliber self-propelled artillery, Browning machine guns, distillation units, and landing vehicles. Big shifts will take place in the aircraft program later.

Materials

THUS MILITARY DEMANDS are expected to keep the tension on steel, copper, textiles, lumber, and petroleum products, to name but a few, for which the underlying cause of shortage will still be lack of manpower.

Small users of scarce materials will get the best break in the next 6 months, as far as the production of new items is concerned. Large users are already getting good-sized allotments for the manufacture of automobile parts, farm implements, railroad replacement equipment, and the like—the production of which will probably be increased still more.

The Selected 72

JUST BEFORE V-E Day, WPB Chairman J. A. Krug granted AA-3 priority ratings for the purchase of machine tools and other make-ready equipment to the 72 industries which will have the biggest reconversion problem. In addition to automobile manufacturers, already tooling up, are these 71 industries:

Consumers' durable goods: Domestic sewing machinery, domestic electric ranges, nonjeweled clocks and watches, metal flashlight cases, mechanical refrigerators, domestic laundry equipment, electric fans, photographic equipment, metal office furniture, flatware, jeweled clocks and watches, domestic vacuum cleaners, sealed-beam lamps, small electric appliances, lawn mowers, wood furniture, metal household furniture, fishing tackle and reels, metal caskets and vaults, band instruments, bedding, bicycles, pianos.

Commercial industrial equipment: Commercial and industrial refrigeration and air-conditioning equipment and machinery and equipment for processing beverages, tobacco, and sugar.

Machinery (construction): Tractor equipment, bituminous equipment, concrete equipment and centrifugal pumps, crushing equipment, graders, miscellaneous construction machinery, power cranes and shovels, road rollers, track-laying tractors.

Plumbing and heating: Boilers, radiators, sanitary enameled ware, and soil pipe and fittings made of cast iron; also commercial cooking equipment (not electric), commercial dishwashing machines, direct-fired water heaters (gas and oil), domestic cooking and heating stoves, electric water heaters, extended surface heating equipment, fabricated piping, formed steel sanitary ware, gas conversion and industrial gas burners, heating controls, high pressure steel boilers, indirect water heaters, low-pressure steel boilers, mechanical stokers, oil burners, plumbing fixture fittings and trim, range boilers and hot water storage tanks, steel septic tanks, vitreous china and semivitreous or porcelain plumbing fixtures, warm air distribution equipment, warm air furnaces, water heaters, (coal and wood).

Printing and publishing: Printing trades machinery.

Service equipment: Barber and beauty appliances, cash registers, floor machines, laundry equipment, office machinery, motion picture equipment (35 mm.), scales and balances, typewriters.

"L" Orders

JUST AFTER V-E DAY Krug revoked 73 "L" orders, promised to clean out 200-odd more within a few months, and authorized non-war producers to place orders for the three CMP materials—steel, copper, and aluminum—for delivery after July 1. But placing orders is one thing and getting deliveries is another. And Krug made it plain that manufacturers would have to scramble for anything left over after WPB-authorized orders had been filled. He also kept a tight grip on plant inventories.

Possibly the most significant aspect of the Krug announcement, therefore, was his issuance of AA-1 priority ratings, effective July 1, to manufacturers who produce less than $50,000 in goods per quarter. This won't trump an essential civilian rating, to be sure, but it will give the "little fellows" a leg up on the big ones in the tussle for any materials in the free market.

Lifting of "L" orders affects: Galvanized ware and metal-coated equipment; electric pumps; paper mill machinery clocks; excavators; hand trucks; industrial and wire cloth for paper-making; commercial coil and tube assemblies; and resistance welding equipment.

Limited civilian radio production is indicated as soon as military requirements fall below 90 percent of the average monthly delivery rate for the first quarter.

An interesting wrinkle: Small civilian planes will beat automobiles to the market by some months. This suggests the thought that some war manufacturers, when cutbacks occur, may be given freedom to use up inventories in their own plants and keep their employees busy on some worthy product—outside labor shortage areas, of course.

Wage Controls

THE LITTLE STEEL FORMULA was given a "duration" lease of life, as was labor's no-strike pledge. In its first significant post-V-E Day move, WLB authorized civilian goods manufacturers to work out their own wage structures without waiting for WLB approval, *if* no change in price ceilings is required. New schedules must be reviewed by the Board, at all events.

This small exception merely emphasized the rule that wage and price control will be maintained until further notice. And OPA chipped in soon afterward with a new announcement on the pricing of new items.

WLB Chairman George W. Taylor explained that, in this move, "the Board in a sense has put its chips on collective bargaining." There was talk in labor circles for a time of suspending the no-strike pledge in non-war plants but this died quickly. One difficulty would be that of drawing the line in plants partially on war, and partially on non-war, production.

Taxes

CORPORATE TAX CONCESSIONS to encourage reconversion are clearly in prospect. Secretary Morgenthau of the Treasury, Chairman George of the Senate Finance Committee, and Chairman Doughton of House Ways and Means are agreed on a five-point legislative program to:

1. Increase the excess profits tax specific exemption from $10,000 to $25,000 effective at the beginning of the 1946 tax year.
2. Provide that the post-war credit of 10 percent of the excess profits tax be taken currently with respect to tax liabilities of 1944 and subsequent years.
3. Advance to January 1, 1946, the maturity date of an estimated $1,500,000,000 of outstanding excess profits tax post-war refund bonds.
4. Provide for speeding-up of refunds resulting from carry-backs of net operating losses and unused excess profits credits.
5. Provide for acceleration of refunds resulting from the recomputation of deductions for amortization of emergency facilities.

Broad reductions in over-all tax rates are not in the cards, however, until after V-J Day. Both President Truman and Secretary Morgenthau have made this plain.

Vinson Report

QUESTIONS AND ANSWERS from the report sent to the President May 9 by Fred M. Vinson, Director of War Mobilization, give industry a good picture of what's ahead:

Distribution of Cutbacks

How will production cutbacks be distributed? Cutbacks will be spread as evenly as possible. However, the changed nature of the Pacific war will affect differently the output of different industries, different areas, and different plants. In general, it is planned to cut back production first in tight labor areas, so that work opportunities may be equalized.

Relaxation of WPB Controls

How will production of civilian goods get started? The WPB will release its controls as quickly as possible. Some can be removed entirely, others may be released on a local basis in the light of local needs for war production. Among the steps which WPB has already taken, or will take in the near future, are:

1. Restoration of the complete operation of the spot authorization plan for approving civilian production through district and regional offices of WPB.

2. Revocation of a number of orders which at present restrict, or prohibit, the manufacture of certain minor durable and semi-durable consumer goods, or that limit the use in such articles of materials which now are no longer critical. Gradual revocation of these orders has already begun.

3. "Open-ending" the Controlled Materials Plan (CMP) so that copper, steel, and aluminum, now channeled entirely by allotments to war production, may be released also to civilian manufacturers for purchase in the free market in such quantities as are no longer needed for war or essential civilian purposes.

4. Removing of "rating floors" from a number of items, now under WPB orders, to permit delivery or production of these items without a special WPB priority.

5. Positive priority assistance for smaller manufacturers and veterans in obtaining needed materials and components so that each will have a fair chance to get his share.

Equipment for the Home

When will it be possible to buy new equipment for the home—radios, washing machines, vacuum cleaners, furniture? Some of the appliances should be available in limited numbers within a year. Washing machines, refrigerators, and other badly needed items will undoubtedly go into production first. Some household needs, such as electric irons and stoves, have been produced in limited quantities during the past two or

three years and production probably will be stepped up in three to six months—as skilled manpower and materials permit.

Provision must be made to see that the most essential civilian needs, such as those of hospitals, are filled first. If there are any appliances left over, they will probably be sold without rationing.

Some civilian radios should be available within the year, but present plans indicate a tight situation. Some items of furniture will continue to be available, but shortages of lumber and heavy textiles may limit production. Generally, as soon as materials are available for civilian production, furniture again will have metal fittings and hardware as in pre-war models.

New Automobiles

When will it be possible to get a new automobile? A few cars may be coming off the assembly lines in six to nine months but it will be a long time before they are produced in really large quantities, and there cannot be enough to meet pent-up civilian demand in less than three years. OPA will see that the most essential users get the first available cars under present rationing program.

Spare parts to keep present cars rolling will continue to be produced at a very high rate. Last year the WPB programmed the manufacture of $750,000,000 worth of auto and truck parts. Cars at present average nearly eight years of age, truck nine years, and many will have to last three to four years longer. Greatest parts shortage is in batteries and tires. Need for care of cars was never greater than today.

New Homes

Will it be possible to build new homes soon? Home building already is under way on a limited scale where necessary to relieve congestion, but only where manpower and materials can be spared. Many kinds of building materials will probably remain in short supply for some time. However, returning veterans are given priorities for home building; priorities also are granted in cases of hardship. Restrictions on home building will not end until manpower and materials are generally available. At least 250,000 homes and apartments are expected to be built during the next 12 months, although the figure might be as high as 400,000. Essential repairs can be made now.

Surpluses of War Goods

Will surpluses of war goods be available to civilians, thereby helping to supply the demand for new civilian goods? Surpluses will be sold mainly through dealers and distributors, not to individual consumers. An exception to that rule is provision for direct sales to veterans who wish to buy surpluses to establish themselves in business, the professions, or agriculture. While total surpluses are expected to run into many billions, surplus consumer goods are not likely to amount to enough to compete seriously with new production. Instead, they should serve a useful purpose in filling civilian needs for many items that will be difficult to obtain before manufacturing gets into full production.

Control of Wartime Inflation

Will wartime inflationary pressures continue after V-E Day? Yes. They will be serious. Purchasing power will continue to exceed supply. Total income will continue to be high.

Price and rationing controls, wage controls, high taxes, and continued War Bond sales will be essential in keeping consumer buying within bounds. People will be encouraged to buy only what they need and to keep up their War Bond purchases.

OPA will continue price ceilings on items now available and will establish prices on newly manufactured goods. These will be continued to prevent inflationary tendencies. Production of more civilian goods will not, for a while, make price control easier.

Continuance of Wage Controls

Will wage controls be lifted? Removal of wage controls at this time would be certain to increase the cost of producing goods. Producers would have to charge higher prices to cover their costs of production. This would cause the cost of living to go up. As the cost of living rose, wages would have to be raised again. Such a merry-go-round of wage and price increases not only would fail to help workers, but also would be a sure way to bring on a collapse after the war. Both prices and wages must be stabilized as long as this danger exists. Stabilization does not mean that wages will be frozen. Unfair wage rates will be adjusted; substandard wages will be raised.

The War Labor Board has the power to set floors under wages as well as ceilings over them. This power can be used when it appears that wages are likely to be forced downward rather than upward, and every attempt will be made to prevent drastic and unwarranted wage cuts.

Length of Work Week

Will the 48-hour work week continue after V-E Day? In many industries and communities, yes. As victory over Japan draws near, workers in consumer goods industries may return gradually to the 40-hour week. War industries will, however, remain on the 48-hour schedule, except possibly in construction of merchant ships in which the emergency program runs out December 31, 1945, or in those war industries which have taken a heavy cutback and where pay rates are high.

Reduction of Taxes

Will there be an early reduction of taxes? This matter will be decided by the Congress, but it has been recommended that no general reduction in taxes be made until after Japan is defeated. New tax programs are being planned for the post-V-E Day period to stimulate reconversion and new enterprises.

Motion-Time Standards

A modern technique that uses tested time values in establishing rates on manual motions, thereby putting time study on a sound, scientific basis

J. H. QUICK
Industrial Engineer

W. J. SHEA
Manager of Parts Fabrication

R. E. KOEHLER
Industrial Engineer

RCA Victor Division, Radio Corporation of America, Camden, N. J.

1. Why Motion-Time Standards

EVERY SECOND OF THE WORKING DAY American industry needs more than 200,000,000 manual motions! In one year an average worker moves his hands 5000 miles, a distance equal to crossing the Pacific Ocean!

Throughout the history of scientific industrial management, increasing emphasis has been accorded the need for correct work motions in factory operations—for maintaining reasonable productivity and eliminating unnecessary fatigue. Educating management and labor to the value of motion economy and work simplification has developed one of industry's most powerful weapons against waste.

Motion study and work simplification have achieved such prominence throughout industry that many people have come to overlook the importance of time study in not only achieving, but also maintaining, high factory performance. From actual experience it is apparent that the full benefits of work simplification are not obtained unless it is possible accurately to measure the amount of work that has been eliminated by the improvement.

* * *

The authors wish to make due acknowledgment to S. F. Benner (now works manager of the Watsontown, Pa., plant of Philco Radio Corporation), with whom they were associated in 1936, and under whose guidance this work on motion-time standards was first undertaken.

Contrary to the impression presented by many texts, the pure science of accurate time study has no connection with motion study. Time study seeks to *measure* the time required to perform a task, whereas motion study seeks to *reduce* the time required. Scientific time study measures performance and therefore puts the worker on his mettle. It tells him *what is a fair day's work for a fair return in wages.*

There has for many years been a great deal of criticism directed at time study engineers and so-called "efficiency engineers." To some extent

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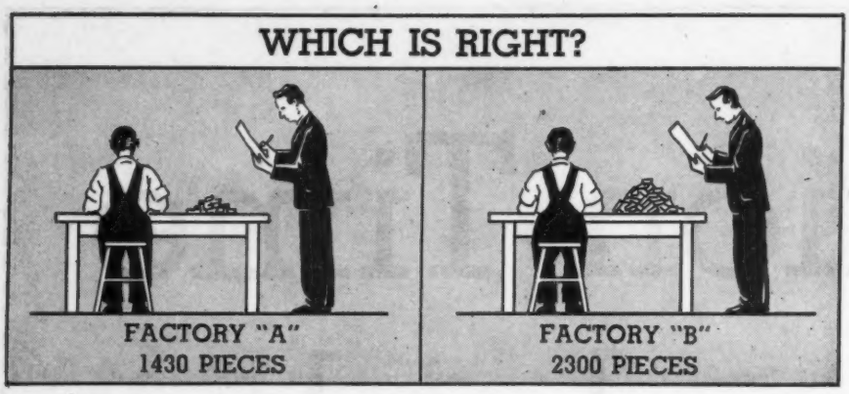


Of 100 rates established on a simple manual operation by 100 experienced time study men, 62 were different. And the variation between the loosest and the tightest rates was 61 percent

the criticism is justified, as the following would indicate.

At an industrial conference more than 100 time study men from different industries were tested on the simple operation of placing a washer on a bolt. Conditions were standardized, each man was given samples of the parts, and films of the operation were shown.

Of the 100 rates established, 62 were different! In no case did more than three experts agree on any value. If the operation had been performed in each of the plants represented, labor standards would have shown a variation of 61 percent. In other words, a worker in one plant would be required to produce 2300 pieces per hour, whereas a worker in a neighboring plant would be required to assemble only 1430 units to earn the same wages!

Scientific management demands that manual motions be measured in terms of time, not for the fast worker, not for the slow worker, but for an average against which all may be compared. For more than 60 years such measurement has been attempted by dividing an operation into elements and observing the duration of each with a stopwatch. To the opponents and critics of time study, the stopwatch has symbolized its inadequacies.

Educated workers do not object to time study or to wage incentive plans. Basically they favor such systems, but they object to production rates based on human judgment. People want to be given equal opportunity. They fear partiality. They distrust a system that does not have a sound scientific basis which can be summarized in printed form. They are suspicious of anyone who rates their efficiency upon nothing more concrete than his opinion of their skill and effort.

What is clearly necessary, if time study is to gain the complete confidence of operators, unions, managements, and those in "certain high quarters," is a common scientific basis for the establishment of true labor standards in all industries. When such information is finally available and accepted, the results will make possible a bridge of fair dealings to span much of the present industrial turmoil—a bridge over which management and labor can move with confidence and harmony toward a sound system of wage payment.

The following discussion of the applied mathematics of manual motion is offered not as a panacea, but rather as a means of arousing interest in a modern method of establishing rates quickly as well as accurately, yet avoiding errors inherent in the stopwatch technique.

In the discussions to follow, all values and data are in terms of single motions; for example, in picking up a pencil, there are actually three separate movements, not just one:

1. Movement of the hand to the pencil
2. Grasping of the pencil by closing the fingers
3. Return motion carrying the pencil toward the paper

In motion time analysis each motion is analyzed separately. The sum of the times for the three motions equals the over-all time required to pick up the pencil.

For some time those interested have sought to measure the properties of the human body as they affect industrial performance. Applied to time study, this work culminated in the development of tables showing the time to be allowed for performing motions with the various body members according to the distance moved. The time values in the table below afford some idea of the results obtained by four leading engineers in the field. The values have contributed toward eventual establishment of consistent time study standards in that they "broke the ice," stimulated thinking along scientific lines, and gave others a basis on which to work.

At first glance there appear to be irreconcilable discrepancies in the times established. Actually the differences, although serious, are not so great as they seem. When each value is applied in accordance with its originator's interpretation, somewhat more consistent answers result.

There are, however, two major reasons why these time values are not

How Time Values Differ

Body Member	Distance Moved	Time in Min.	Established by Engineer
Finger	1″	0.0018	A
		0.0017	B
		0.0017	C
		0.0015	D
Forearm	6″	0.0019	A
		0.0029	B
		0.0033	C
		0.0025	D
Arm	18″	0.0030	A
		0.0064	B
		0.0080	C
		0.0045	D

Four experienced time study engineers set the above time values on three simple manual motions. The inconsistent results illustrate need for standards that take all important variables into account

entirely satisfactory in evaluating factory operations:

1. The time values do not recognize the additional time required to compensate for factors such as weight handled, control necessary, size and shape of various objects.

2. Athough distinctions between similar body members are clearly set forth in the literature, they prove difficult to recognize in actual practice.

Accordingly, it is desirable to set up motion-time standards which take into account all important variable factors occurring in practice, are simplified so that they can be used quickly and conveniently in time study work, and can be easily understood.

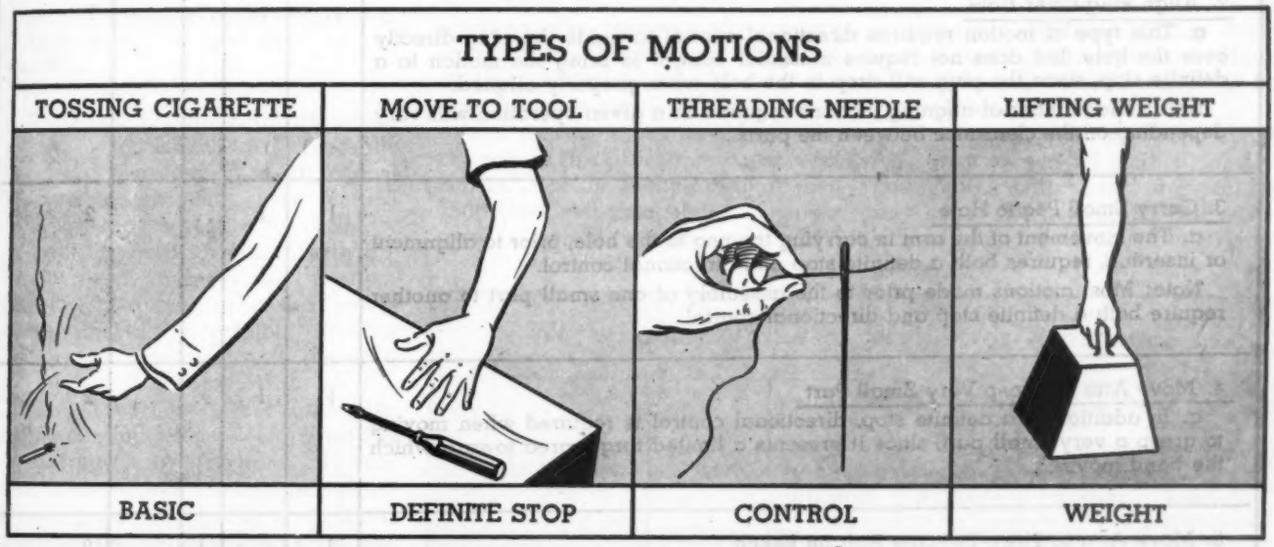
2. Four Major Variables

When Sir Isaac Newton first recorded the laws of motion, they were considered only in connection with inanimate objects. However, experiments have shown that the same laws apply to motions of the human body. It is only the complexity of man's physical structure that has inhibited a more complete analysis of the relations between time required and (1) distance moved, (2) body member used, (3) manual control involved, (4) weight carried:

1. Distance Moved. Other things being equal, it takes less time to move a short distance than to move a long one. This applies whether the movement be walking along the street, riding a bicycle, sailing a boat, or moving the arm. The shorter the distance, the shorter the time—hence the proverbial "short cut" to save time.

Other facts about time and distance may not be so apparent at first. For example, to move the hand 10 inches requires less than twice as much time as to move it 5 inches; the farther it is moved within normal limits, the faster it travels per inch.

The photograph on this page was taken with the aid of a high-speed, high-intensity, stroboscopic lighting unit. The time interval between exposures is constant. Note that the distance between exposures increases as the hand is moved away from the zero position. This represents the starting acceleration. The deceleration that takes place at the end of the motion is represented by the decrease in the distance between exposures as the hand approaches the 15-in. mark.



Photograph of 15-in. arm motion with stroboscopic light unit. Distances between exposures reveal effect of starting acceleration and deceleration at end of motion as hand approaches mark

Obviously the function of the movement is often more important than the distance moved. The difficulty, skill, effort, or care involved all influence the time required to perform the motion

2. Body Member Used. The human body consists of a group of coordinated movable parts. The hands, arms, trunk, and legs are mechanisms that obey the laws of motion. Therefore, as in physics, any reliable calculations dealing with time must be based on the size, shape, weight, and the leverage arrangements of the bones and tissues. In time study, these factors are classified by indicating the name of the body member involved.

Several years of experience have indicated that the following classification of body members is most practical

Analysis of Control Required in Representative Manual Motions

Motion Description	Control Work Factors: Definite Stop	Directional Control	Care	Change Direction	Total Control Work Factors
1. Toss Washer Into Totepan a. A tossing motion does not require that the hand be brought to a definite stop. b. The directional control required is negligible because the totepan provides a large target area. c. No care is required; no likelihood of danger or injury. d. No change of direction is involved in the motion. Note: This type of motion is very simple to perform and therefore requires no control. Most ballistic-type motions such as striking a key or walking are also analyzed as requiring no control.	..	..	..	..	0
2. Align Plug Over Hole a. This type of motion requires directional control to guide the plug directly over the hole, but does not require muscular control to bring the motion to a definite stop, since the plug will drop in the hole when properly aligned. Note: The number of aligning motions required in a given operation will vary depending on the clearance between the parts.	..	1	..	..	1
3. Carry Small Peg to Hole a. The movement of the arm in carrying the peg to the hole, prior to alignment or insertion, requires both a definite stop and directional control. Note: Most motions made prior to the assembly of one small part to another require both a definite stop and directional control.	1	1	..	..	2
4. Move Arm to Grasp Very Small Part a. In addition to a definite stop, directional control is required when moving to grasp a very small part, since it presents a limited target area toward which the hand moves.	1	1	..	..	2
5. Move Arm to Place Delicate Part on Bench a. This motion involves a combination of definite stop at the bench top, plus care to prevent damage to the part as it touches the bench.	1	..	1	..	2
6. Reach Behind Panel to Grasp Bolt a. This type of motion requires a change of direction to move around the panel and at the same time requires a definite stop preparatory to the grasp. Note: The presence of the change of direction type of control is rare in well-planned motion patterns.	1	..	..	1	2
7. Move 1-In. Micrometer to Shaft Prior to Measuring a. Muscular control is required to bring the micrometer to a definite stop. b. Directional control is required because of limited clearance between the shaft and the jaws of the micrometer. c. Care is required to prevent striking the micrometer against the shaft.	1	1	1	..	3
8. Move Arm Around Post to Assemble Screw to Hole a. This type of motion requires a combination of a definite stop, directional control, and a change of direction.	1	1	..	1	3

Table illustrates method of analyzing work factors involved in representative motions. It proves how simple it is to analyze degree of control required in the performance of any manual motion

for the application of motion-time values:

Finger, hand, forearm, arm

Foot, leg, trunk

In this article, discussions of the time required for movements pertain to those used in the performance of manual work over prolonged periods. As the human body has only limited recuperative ability, the worker in a shop or office must adjust his expenditure of energy so that with normal rest periods he can continue production throughout his working year. In an emergency he may easily move his forearm or trunk as quickly as his finger, but obviously he would be exhausted if he were to attempt as many arm movements in a day as it is possible for him to make with his fingers.

In the shop a worker's pace must be coordinated with the recuperative powers of his own body. He cannot expect to dissipate more energy over a long period of time than he can build up.

3. **Manual Control Involved.** Workers do not calculate mathematically the forces involved in their manual movements, but they have learned from experience that it is necessary to vary the speed of motion with the task at hand. Actually, in the shop, the efficient worker makes each movement as rapidly as possible provided the speed is consistent with the overall rhythm of the job itself.

Manual motions do not differ basically from any others. If the hand is to be moved to perform a delicate task, such as painting a picture or assembling a watch spring, it is necessary that the forces affecting the motion be carefully coordinated. The weight of the member itself, the instrument or brush it carries, the speed of motion, and the exertions of the many muscles must all be blended into a controlled movement if accuracy and precision are to be obtained.

For example, in the familiar motions involved in eating and drinking, some manual movements may require more control than others. It is easily understood that more time is required to carry a brimming cup of hot coffee to the lips than to move the same distance with a napkin. The former motion is more difficult and hence slower because care is necessary to avoid spilling the coffee, and to prevent the cup from colliding with the teeth. The same principles are true in factory operations. Men performing crude work may move rapidly and with little care. The same men on delicate jobs must apply skill—and move more slowly, using control.

Therefore, in establishing the time allowance for any manual motion, it is necessary to consider the amount of control involved in the motion.

4. **Weight Carried.** A sprinter may be able to run 100 yards in 10 seconds. However, no matter how great his stamina or how perfect his physique and skill, a 20-lb. weight would slow him down.

Plain as the weight-time relationship may be, few industrial time study departments are set up to compensate scientifically for manual motions in proportion to weight carried. Nor in most cases is the resistance involved in lever manipulation, in rubbing, sanding, and filing motions adequately understood in terms of time.

The worker recognizes the effect of both weight and resistance on his work motions and is rightfully concerned, because without full consideration of this factor, fair wage payment is not possible.

3. How Data Were Collected

A THOROUGH STUDY of manual motions has revealed that several additional variables exist, such as direction of the motion and location of the work area. The study is of scientific value, but in actual use is too unwieldy for practical application, since it is a difficult and lengthy process to separate six or seven variable elements when rating an operation. Furthermore, the effect of the additional variables on total time values is relatively negligible.

The moving times on which conclusions in this article are based were derived from the analysis of more than 1500 elemental time studies of punch press, assembly, plating, and various machine operations typical of the average manufacturing plant. Since all industrial operations are related in terms of manual motions, the results are applicable to practically any type of factory work.

When the experimental data were plotted, prior to the establishment of motion-time standards, certain basic inconsistencies seemed to exist. However, after study, what appeared to be illogical became clear fact.

For example, there seemed to be no logical reason why all methods of disposing of a bolt should not require the same time; however, the data showed that, when the motion was

Work Factor Value of Weight or Resistance

Body Member	Sex	No. of Weight or Resistance Work Factors							
		0		1		2		3	
		Pounds		Pounds		Pounds		Pounds	
		Over	Inc.	Over	Inc.	Over	Inc.	Over	Inc.
Finger-Hand	Male	0	⅔	⅔	2½	2½	4	4	Up
	Female	0	⅓	⅓	1¼	1¼	2	2	Up
Arm	Male	0	2	2	7	7	13	13	Up
	Female	0	1	1	3½	3½	6½	6½	Up
Forearm Swivel*	Male	0	3	3	13	13	Up	..	..
	Female	0	1½	1½	6½	6½	Up	..	..
Foot	Male	0	5	5	22	22	Up	..	..
	Female	0	2½	2½	11	11	Up	..	..
Leg	Male	0	8	8	42	42	Up	..	..
	Female	0	4	4	21	21	Up	..	..
Trunk	Male	0	11	11	58	58	Up	..	..
	Female	0	5½	5½	29	29	Up	..	..

*Note: Forearm swivel work factor limits are expressed in inch-pounds of torque.

Weight to be moved in making the motion is measured: table supplies number of work factors to be used in classifying the motion

Motion-Time Table . . .

Distance Moved, Inches	Basic	Work Factors 1	2	3	4	Distance Moved, Inches	Basic	Work Factors 1	2	3	4
(A) Arm — *Measured at Knuckles*						(L) Leg — *Measured at Toe*					
1	.0018	.0026	.0034	.0040	.0046	1	.0021	.0030	.0039	.0046	.0053
2	.0020	.0029	.0037	.0044	.0050	2	.0023	.0033	.0042	.0051	.0058
3	.0022	.0032	.0041	.0050	.0057	3	.0026	.0037	.0048	.0057	.0065
4	.0026	.0038	.0048	.0058	.0066	4	.0030	.0043	.0055	.0066	.0076
5	.0029	.0043	.0055	.0065	.0075	5	.0034	.0049	.0063	.0075	.0086
6	.0032	.0047	.0060	.0072	.0083	6	.0037	.0054	.0069	.0083	.0095
7	.0035	.0051	.0065	.0078	.0090	7	.0040	.0059	.0075	.0090	.0103
8	.0038	.0054	.0070	.0084	.0096	8	.0043	.0063	.0080	.0096	.0110
9	.0040	.0058	.0074	.0089	.0102	9	.0046	.0066	.0085	.0102	.0117
10	.0042	.0061	.0078	.0093	.0107	10	.0048	.0070	.0089	.0107	.0123
11	.0044	.0063	.0081	.0098	.0112	11	.0050	.0072	.0094	.0112	.0129
12	.0046	.0065	.0085	.0102	.0117	12	.0052	.0075	.0097	.0117	.0134
13	.0047	.0067	.0088	.0105	.0121	13	.0054	.0077	.0101	.0121	.0139
14	.0049	.0069	.0090	.0109	.0125	14	.0056	.0080	.0103	.0125	.0144
15	.0051	.0071	.0092	.0113	.0129	15	.0058	.0082	.0106	.0130	.0149
16	.0052	.0073	.0094	.0115	.0133	16	.0060	.0084	.0108	.0133	.0153
17	.0054	.0075	.0096	.0118	.0137	17	.0062	.0086	.0111	.0135	.0158
18	.0055	.0076	.0098	.0120	.0140	18	.0063	.0088	.0113	.0137	.0161
19	.0056	.0078	.0100	.0122	.0142	19	.0065	.0090	.0115	.0140	.0164
20	.0058	.0080	.0102	.0124	.0144	20	.0067	.0092	.0117	.0142	.0166
22	.0061	.0083	.0106	.0128	.0148	22	.0070	.0096	.0121	.0147	.0171
24	.0063	.0086	.0109	.0131	.0152	24	.0073	.0099	.0126	.0151	.0175
26	.0066	.0090	.0113	.0135	.0158	26	.0075	.0103	.0130	.0155	.0179
28	.0068	.0093	.0116	.0139	.0159	28	.0078	.0107	.0134	.0159	.0183
30	.0070	.0096	.0119	.0142	.0163	30	.0081	.0110	.0137	.0163	.0187
35	.0076	.0103	.0128	.0151	.0171	35	.0087	.0118	.0147	.0173	.0197
40	.0081	.0109	.0135	.0159	.0179	40	.0093	.0126	.0155	.0182	.0206
Weight (Pounds) Male	2	7	13	Up	-	*Weight (Pounds)* Male	8	42	Up	-	-
Fem.	1	3½	6½	Up	-	Fem.	4	21	Up	-	-

Values in table are not a record of actual performance (fast or slow), but represent what can be expected from an operator working with good skill, good effort, under standard working conditions

tossing the bolt into a totepan, it took considerably less time than when the bolt was placed in an assembly, even though the distance moved by the arm was the same. The reason is simple enough; in the latter case, it was necessary for the hand to slow down prior to placing the bolt so as not to overshoot the target.

Also the data were questioned when it was found that tossing a 2-lb. part into a large transport took no longer than an empty hand moving over the same distance to grasp a small tool at the workbench. Again it became necessary for the hand to slow down before grasping the tool, while in the tossing motion no such control was necessary. Similarly the data indicated that to toss a 12-lb. part into a large transport took just as long as to transport a 2-lb. part to a punch press die.

In the shop the time for two 4-in. motions may differ as much as 200 percent, and a 3-in. motion often requires twice as much time as a 6-in. motion even though it is only half as long.

From the above it is evident that movements of exactly the same length may take different times, while movements of different lengths may take the same time. Obviously the function of the movement is just as important as, sometimes more important than, the distance moved or the body member used. In classifying each motion by its function, it is apparent that the time values seem to follow a fixed pattern and that the number of variable factors is more important than the type of motion.

The amounts of control (skill or care) required to perform a given motion can be converted into factors which are interchangeable in terms of their *effect* on the time required to perform a motion.

This reasoning led to a new and significant concept which has been described as the *work factor*—essentially a device for rapid, simplified classification of the variables which exist in manual work as they influence moving time. Briefly, *the work factor is an index of the difficulty, skill, effort, or care involved in the performance of manual motions.* All other variables being constant, the greater the number of work factors, the longer is the time required to perform a given movement.

4. Identifying Work Motions

CLASSIFIED TIME VALUES set up in tables can be accurately converted into shop rates for any combination of manual motions involved in a given operation. In brief, a yardstick is required by which the difficulties involved in all motions can be easily recognized and measured so that time

...Select Time in Minutes

Distance Moved, Inches	Basic	Work Factors 1	2	3	4
(T) Trunk — *Measured at Shoulder*					
1	.0026	.0038	.0049	.0058	.0067
2	.0029	.0042	.0053	.0064	.0073
3	.0032	.0047	.0060	.0072	.0082
4	.0038	.0055	.0070	.0084	.0096
5	.0043	.0062	.0079	.0095	.0109
6	.0047	.0068	.0087	.0105	.0120
7	.0051	.0074	.0095	.0114	.0130
8	.0054	.0079	.0101	.0121	.0139
9	.0058	.0084	.0107	.0128	.0147
10	.0061	.0088	.0113	.0135	.0155
11	.0063	.0091	.0118	.0141	.0162
12	.0066	.0094	.0123	.0147	.0169
13	.0068	.0097	.0127	.0153	.0175
14	.0071	.0100	.0130	.0158	.0182
15	.0073	.0103	.0133	.0163	.0188
16	.0075	.0105	.0136	.0167	.0193
17	.0078	.0108	.0139	.0170	.0199
18	.0080	.0111	.0142	.0173	.0203
19	.0082	.0113	.0145	.0176	.0206
20	.0084	.0116	.0148	.0179	.0209
Weight (Pounds) Male	*11*	*58*	*Up*	-	-
Fem.	*5½*	*29*	*Up*	-	-

Distance Moved, Inches	Basic	Work Factors 1	2	3	4
(F, H) Finger-Hand — *Measured at Finger Tip*					
1	.0016	.0023	.0029	.0035	.0040
2	.0017	.0025	.0032	.0038	.0044
3	.0019	.0028	.0036	.0043	.0049
4	.0023	.0033	.0042	.0050	.0058
Weight (Pounds) Male	*⅔*	*2½*	*4*	*Up*	-
Fem.	*⅓*	*1¼*	*2*	*Up*	-
(FT) Foot — *Measured at Toe*					
1	.0020	.0029	.0037	.0044	.0051
2	.0022	.0032	.0040	.0048	.0055
3	.0024	.0035	.0045	.0055	.0063
4	.0029	.0041	.0053	.0064	.0073
Weight (Pounds) Male	*5*	*22*	*Up*	-	-
Fem.	*2½*	*11*	*Up*	-	-
(FS) Forearm Swivel—*Measured at Knuckles*					
45°	.0017	.0022	.0028	.0032	.0037
90°	.0023	.0030	.0037	.0043	.0049
135°	.0028	.0036	.0044	.0052	.0058
180°	.0031	.0040	.0049	.0057	.0065
Torque (Inch-Pounds) M.	*3*	*13*	*Up*	-	-
P.	*1½*	*6½*	*Up*	-	-

Work Factor Symbols	
W	Weight or Resistance
S	Directional Control (Steer)
P	Care (Precaution)
U	Change Direction
D	Definite Stop

Walking Time			
	30″ Paces		
TYPE	1	2	OVER 2
General	.015	.026	.012 + .008/Pace
Restricted	.018	.030	.012 + .010/Pace
Add .010 for 120° — 180° Turn at Start			

Visual Inspection	
Focus	.002
Inspect	.003/point

Allowances for fatigue, normal delays, and personal needs are not included in the values in the above table. Compensation of this nature must be established to fit the needs of the specific plant

values can be quickly and accurately applied from a "motion-time table."

Distance is perhaps the easiest of the variables to recognize. All that is necessary is to measure it with a scale and select on the motion-time table the value indicated.

Identifying the *body member* used is merely a matter of observation. In the performance of manual work it is easy to recognize whether the foot, arm, finger, etc., is being used.

Control is the most complex and deceptive of the variables influencing manual motions, because there is no physical measuring device with which its effects can be checked. With no definite units such as inches or pounds for control, the previously mentioned work factor becomes a means by which the several types and degrees of control can be classified. The following types of manual control are most commonly encountered in industrial work:

1. *Definite Stop* (manual control required to terminate a motion with a definite stop).

2. *Directional Control* (manual control required to direct or steer a motion through limited clearance or toward a small target area).

3. *Care* (manual control required, or precaution exercised, to prevent damage or injury, or to maintain manual control).

4. *Change of Direction* (manual control required to change the direction of a motion such as moving around an obstruction).

Although an infinite number of control factors could be established, the four listed above are based on tabulated data which have indicated that more than 95 percent of all industrial work motions involve control that can be clearly identified by the above factors. Time values classified accordingly make it possible to select them from a table in proportion to the control existing in the motion. The 5 percent of industrial work motions not included in the table can also be accurately identified, but in a somewhat more complex manner not to be discussed in this article.

Weight or *resistance*, measured in pounds, presents little or no problem in the determination of the extent to which either exists in a given motion. All that is required is a spring scale or balance to weigh the loads involved. By setting up the motion-time table for each of the several weight classes, the proper time value can be made available for any condition likely to occur in the shop.

Where the weight handled in a work motion is small compared to the weight of the body member employed, it can be ignored without introducing appreciable error.

A rather extensive study revealed that the effect of weight on time varies with several items, most important of

which are: (1) Body member used; (2) sex of operator.

As in control, the work factor is used as an index of the effect of weight on the time required to perform manual motions.

The factor of *resistance* is found in movements such as bending heavy wire, pushing against a spring, assembling tight-fitting parts, rubbing, and sanding. Data indicate that the same principle governs the effects of resistance and weight.

It is assumed that heavy weights will not be encountered in ordinary repetitive operations where time study analysis is useful. Good manufacturing practice requires that mechanical handling devices be used where abnormal weights are involved.

5. Applying Work Factors

BEFORE CONSIDERING work factors in more detail, the reader should fix clearly in his mind the distinction between the four major variables and the work factors used in conjunction with them.

The *four major variables* actually affect the time required to make manual motions. *Work factors* are a unit devised only for measuring or identifying the effect of two of the four variables—*weight* and *control*. The other two variables, *distance* and *body member*, are measured in terms of inches and the member used, respectively, and will not enter into the discussion of work factors.

As stated before, *control* and *weight* (or *resistance*) affect the time to make a motion regardless of *distance* and *body member*. To facilitate an understanding of the work factor principle, the reader has but to recognize that it is merely a means of describing the motion according to the amount of *control* or *weight* involved in its performance.

Since the value of a work factor in terms of time has been established in tabular form, it remains only for the analyst to become familiar with the elements of control or weight which are equivalent to a work factor. For example, he soon learns that, when the arm is moved with no concern for direction or stopping points, when no care is required to avoid surrounding objects, and when the hand carries no weight and meets no resistance, it requires a minimum of worker output. Therefore, it is a "no control" and a "no weight" motion. When its distance has been measured and the body member is identified as the arm, it is easily recognized as the simplest type of arm motion of a given number of inches.

Instead of referring to it as an "easy" or "simple" or "free" motion, the analyst uses the term "basic." In the same manner he learns to classify more complex motions according to their difficulty.

"Basic" then comes to represent a minimum amount of worker output (not considering distance or body member used) so that, regardless of the distance moved or body member used, all basic motions are "no work factor" motions, and any motion requiring a greater degree of control or effort must automatically be classed as a 1, 2, or 3 work factor motion, according to the function it performs.

Since the simplest or basic motion involves no work factors, it is apparent that, as complexities are introduced to a motion, they add work factors and consequently time.

The exhibit on page 100 indicates the method of analyzing the control work factors involved in representative manual motions. After reading the motion descriptions, it is a rather simple matter to analyze the degree of control required in the performance of any manual motion.

The use of the work factor principle in evaluating motions requires that the weight involved as well as the control required be put into terms of work factors.

The problem here is much simpler than in the case of control, since after measuring the amount of weight to be moved in making the motion, reference to the table on page 101 will supply the number of work factors to be used in classifying the work motion.

There are an unlimited number of "basic," "1 work factor," "2 work factor," or "3 work factor" motions, all somewhat different as to function yet requiring equal time to perform so long as an equal number of work factors are involved. The complexity of the motion is dependent on the amount of control, weight, or resistance, which in turn determines the number of work factors.

Because of the manner in which the work factor unit has been set up, it makes no difference whether a given motion involves 2 factors of control and 1 of weight, or 2 of weight and 1 of control. The motion is valued at 3 work factors and as such can be identified on the motion-time table. The cause for the work factors does not affect time; it is the total number of factors that determines the time.

The use of the work factor unit makes it possible to construct a sim-

Study of everyday operation provides easy way to illustrate extent to which time study may become a more exact science. Work involves getting pen from holder, marking *X* on paper, replacing pen in holder, returning hand to paper. See analysis on facing page

Analysis of Manual Motions

(see photograph on facing page)

No.	Elemental Description	Motion Analysis	Moving Time in Minutes
1	Move arm to pen	A12D	.0065
2	Grasp pen	F1	.0016
3	Move to paper	A12D	.0065
4	Position pen on paper	F1SD	.0029
5	Make 1st stroke of X	F1D	.0023
6	Position pen for 2nd stroke	F1D	.0023
7	Make 2nd stroke	F1D	.0023
8	Move pen to holder	A12SD	.0085
9	Insert pen in holder	F1P	.0023
10	Release pen	½F1*	.0008
11	Move arm to paper	A12D	.0065
	Total		.0425

*The release of the pen is analyzed as a ½ finger motion since it is only necessary to break contact with the surface of the pen in order to start the arm motion back to the paper. Any additional motion that might take place in the opening of the fingers would be simultaneous with the arm movement and therefore need not be allowed.

Analysis of operation on facing page shows how motions are classified and times secured from the motion-time table (pages 102 and 103)

ple and concise motion-time table with only two variables—*distance* and *number of work factors*. Since the work factor is a fixed unit with respect to its effect of time, it can be used as a common denominator for translating the elements of manual work into time.

Familiarity with the fundamentals of motion time makes the evaluation of actual shop operations comparatively simple. By listing the motions of the operation on the analysis sheet and analyzing each in terms of the number of control and weight work factors involved, the correct time value can be selected according to the distance and body members used.

6. The Motion-Time Table

PROPER USE of the motion-time table (pages 102 and 103) makes it necessary to identify each motion in terms of the following variables:

1. Body member used
2. Distance moved
3. Number of work factors

Body Member Used. Separate tables have been set up as listed below:

Symbol	*Body Member*
F	Finger
H	Hand
FS	Forearm swivel
A	Arm
FT	Foot
L	Leg
T	Trunk

The body member used to perform a given motion should be identified in the motion analysis by the letter symbols listed herewith.

Distance Moved. All motions are measured in terms of inches except forearm swivel movements, which are measured in degrees of a revolution. Therefore, the distance moved in the motion analysis can be represented merely by a number which will indicate the inches or degrees of a revolution moved. Each motion-time table is so constructed that the distance moved can be located on the left-hand side.

Work Factors. These factors may be identified as already discussed, and are indicated in the motion analysis by the following symbols:

W—Weight or resistance
S—Directional control (steer.)
P—Care (precaution)
U—Change direction
D—Definite stop

With the above guides in mind, it now becomes possible to record all the variables involved in the performance of a manual motion in a simple, symbolic form. In recording the motion analysis, the body member is indicated first, the distance moved second, and the work factors third. Below are examples of the method of recording motion analyses:

1. An 8-in. basic arm motion, made to toss a metal washer into a totepan is analyzed as *A8*. The time value for this motion can be obtained by referring to the arm motion-time table under the column entitled "Basic" and opposite "8 Inches." The time is 0.0038 minute. Since this is a basic motion, no work factor symbols are recorded.

2. A 12-in. leg motion, used in actuating a foot pedal which offers a resistance of 15 pounds, is analyzed as *L12W*. The resistance work factor is derived from the use of the weight limits shown on the motion-time table. The time for this motion is 0.0075 minute and is obtained by selecting the value in the "1 Work Factor" column of the leg motion-time table, opposite "12 Inches."

3. A 6-in. arm motion, used in carrying a small peg to a hole, is represented as *A6SD*. The directional control (steer) work factor is used because the movement is made to a small target, and the *D* represents a definite stop work factor. The time for this movement is 0.006 minute and can be found on the motion-time table under the "2 Work Factor" column of the arm table, opposite "6 Inches."

4. A 10-in. arm motion, made by a male operator to carry a 10-lb. weight from one location to another on a bench, would be analyzed as *A10WWD*, meaning an arm motion 10 inches long with two work factors for weight and one for a definite stop. The time for this motion is 0.0093 minute and can be found under the "3 Work Factor" column of the arm table, opposite "10 Inches."

5. The motion made to grasp a pencil would be analyzed as *F1*, which represents a finger motion of 1 inch

or less with no work factors. The time value from the finger-hand motion-time table is 0.0016 minute and can be found under the "Basic" column opposite "I Inch."

When the same type of motion occurs more than once in sequence in the performance of an operation, the number of occurrences is indicated before the body member symbol. For example:

1. It may require three 1-in. finger motions to pre-position a bolt by turning it end for end. This series of motions is analyzed as *3F1*, meaning three finger motions of 1 inch or less in length. The time for this series of motions can be derived by multiplying the value for a 1-in. basic finger motion by 3. Therefore 3 x 0.0016 = 0.0048 minute.

2. In aligning one part with relationship to another, it may be necessary to make two arm motions, each less than 1 inch, with directional control. Such a pair of motions is analyzed as *2A1S*, meaning two arm motions of 1 inch or less in length and a directional control work factor. The time for this pair of motions is 0.0052 minute.

Walking Time. The motion-time table provides time values for walking for two sets of conditions indicated as "general" and "restricted." General walking refers to a condition under which no obstruction or interference is presented to the operator. Restricted walking covers a condition where the operator has to walk through congested areas, or over slippery floors, or is required to carry a heavy load.

Operation Name	ASSEMBLE BOLT AND WASHER	
	LEFT HAND	
No.	Elemental Description	Motion Analysis
1	Move to bolt	A8D
2	Grasp bolt	F1
3	Separate (Ave. 25%) *	2F1
4	Fumble (Ave. 25%) *	2F1
5	Simultaneous grasp allowance *	-
6	Carry bolt to work area	A8D
7	Pre-position bolt (Ave. 50%) *	3F1
8	Approach bolt to washer	A1SD
9	Align bolt with hole	A1S
10	Insert bolt in washer	A1
11	Release assembly	½F1 **
12		
13		
14		
15	* A manual has been prepared	
16	of moving time values. This	
17	on a percentage basis, as	
18	to grasp two parts	
19	** See note associated with	

Visual Inspection. The time values shown on the motion-time table for visual inspection represent the time to focus the eyes on a given object and then to perform the actual inspection for each item or "point" to be inspected. In manual assembly both focus and inspection can generally be performed simultaneously with manual movements and therefore need not be allowed.

7. Scientific Time Study

WHEN THE PRINCIPLE of identifying individual motions is understood, the process of establishing total operation times becomes a matter of observation and arithmetic.

Following the procedure outlined below will result in accurate and consistent time allowances:

1. List all motions necessary to perform the task.

2. Identify each motion in terms of *the distance moved, body member used, and work factors involved.*

3. Select from the table of values the *time required for each elemental motion.*

4. Add individual times to obtain *total time to perform task.*

The only sure way to understand an idea or technique is to test it in detail. Many industrialists have failed to do this, not only in connection with time study, but also with other industrial controls—which may be responsible for much of the misunderstanding, unhappiness, and consequent inefficiency existing in many shops.

A direct and easy way to illustrate the extent to which time study may become a more exact science, is to make an analysis of a simple everyday operation. For a first attempt, and in the interest of simplicity, it is well to use an operation that is easily described. Most people are familiar with the ordinary desk pen and holder set. Pictured on page 104 is a typical office desk with pen set and person performing the operation.

For convenience the pen holder is located about 12 inches from the center of the writing area in order not to interfere with papers and data on the desk. The work to be studied involves getting the pen from its holder, marking a small X on the paper, replacing the pen in the holder, and returning the hand to the paper.

It is suggested that the reader actually perform the operation and check his sequence of motions with those listed. (See page 105.)

If the reader has arranged the workplace so that it agrees with the motion pattern listed above, it is then a simple task to select the time values from the motion-time table and record them in the column marked "motion time in minutes."

If the elemental values are selected and added correctly, their total will be 0.0425 minute, which is equivalent to about 2½ seconds.

It is important at this point to remember that, while it is an easy matter to select the proper time for each motion from the chart, and while it takes but a few minutes to complete the study, actually each value used has the weight of a great many time studies back of it.

Sheet 1 of 1

Cumulative Time		RIGHT HAND			
Elem. Time		Elem. Time	Motion Analysis	Elemental Description	No.
.0054	.0054	.0054	A8D	Move to washer	1
.0016	.0070	.0016	F1	Grasp washer	2
.0008	.0078	.0016	2F1	Separate (Ave. 50%) *	3
.0008	.0086	.0008	2F1	Fumble (Ave. 25%) *	4
.0008	.0094	.0008	-	Simultaneous grasp allow *	5
.0054	.0148	.0054	A8D	Carry washer to work area	6
.0024	.0172				7
.0034	.0206				8
.0026	.0232				9
.0018	.0250	.0094	-	Hold	10
.0008	.0258	.0008	½F1 **	Release assembly	11
					12
					13
					14
which supplies working definitions and rules for the application					15
manual illustrates the method of evaluating motions which occur					16
well as the method of compensating for the additional time required					17
simultaneously, etc.					18
the analysis of marking an X on paper.					19

Study (above) of typical manual assembly operation pictured at right. Motions are first classified, then the correct time values are selected from the motion-time table (see pages 102 and 103)

Since everyone is familiar with writing and thus has acquired normal skill in handling a pen, the plant manager, foreman, union representative, or worker can perform the operation in the time allowed. Therefore, if rates are established from these data, each can actually experience the shop tempo, since all shop rates will be established from the same motion-time table. The plant manager knows the pace he is asking from his workers. The union representatives can physically see and understand what management expects from each of them. The result is consistent labor prices, correctly established—and what is more important, prices that can be explained and discussed with the entire factory personnel.

The study on this pair of pages is a typical manual assembly operation whose counterpart will be found in many shops. Compare the method used and the time allowed with the performance in your shop.

8. Standard-Time Data

IN MASS PRODUCTION SHOPS it is practical and advisable to devote sufficient time to makihg detailed studies of each elemental motion.

In short-order work, on the other hand, it may be necessary for one time study engineer to establish as many as 50 rates per day, depending upon the size of the shop and its volume of business. In many cases, the worker at the bench may perform ten new operations during a single working day. To take detailed studies of all jobs would require approximately one time study engineer for each two or at most three operators. Because this is impractical, rates must be established in the short-order shop just as accurately

as in the mass production shop, but in only a fraction of the time.

This difficult problem can best be solved by establishing time allowances for each work element. These time allowances are then combined to build up standard-time data for groups of elements that regularly occur in a given type of work. In effect, this is standardization. Just as industry changed from individual piece production to mass production of parts, so must time study apply production methods to the establishment of rates.

Many time study engineers have overlooked the fact that most classes of manual work have elements that occur again and again. Rates have continued to be established as though each job were new and different—something entirely unrelated to any other job in industry or even in one shop. Not until they begin making motion-time studies do time study engineers learn the number of similarities that exist in almost all types of manual work. They discover not only that many of the handling elements are identical, but also that cutting time on machine tools follows definite laws dependent on the material, size of cut, finish desired, and other factors.

Motion-time studies make it possible to look at manual work with a new, more definite viewpoint. Standard values have been established for picking up parts of varying sizes and shapes, for assembling them into fixtures or machines, and for storing and packing them. Experiments to determine the best feeds and speeds for specific materials and depth of cuts have uncovered not only standard machine-time values but also better methods.

There are many advantages to the use of time standards other than the rapidity and ease of application. Equally important is the fact that rates can be set from blueprints before production actually starts.

In the progressive shop this can be done not only because time values have been standardized but also because standard times make necessary the advantages of standard set-ups, methods, and motion patterns. Thus all phases of shop performance tend to improve to at least the level where standard-time allowances apply. Unless this type of system is in effect, all too frequently engineers question the efficiency of the jobs they study, but, lacking force or time, conclude by setting the allowance in accordance with the way they find the worker performing, even though both method and tools may be poor.

Establishing rates from prints before the job is in production forces the time study engineer to make allowances only for a standard motion pattern and method.

If the worker's earnings depend on his performance against standard time values, this in turn requires both him and the shop supervisor to plan their work efficiently. If they fail to do so, an operator may move his arms 30 inches when he need move them only 10 inches for the same result. Obviously it will not be possible for him to equal or better the task set by time study.

Upon investigation it is possible to learn wherein the inefficiency exists, thus enabling the shop to conform to the good practice called for by the standard-time values.

9. Worker Reaction

SOMETIMES THE FIRST REACTIONS of workers, union representatives, and supervisors to a time study engineer who measures and prices an operation without using a watch are much the same as might be expected from a group watching a Hindu fakir perform the famous rope trick. First they are surprised, then much interested, and finally eager to disprove what they see.

In nearly every instance, when the motion-time system is introduced in the shop, there is strong resistance. As time goes on, however, first tolerance and then hearty approval replace resentment, until finally the old method is actually in ill repute.

Analysis of labor-management production rate disputes has shown that the irritation most acute in the minds of the workers is based on lack of confidence in the ability of time study to set accurate rates. Inconsistencies, inequalities, and a general uncertainty concerning the fairness of the rate-setting procedure have a strongly adverse effect on both workers and their representatives. As a rule they are not opposed to producing a fair day's work, but cannot be convinced that a time study engineer's judgment proves a piece rate is correct.

When the shop organization is convinced that the problem of labor measurement is being tackled scientifically, in most cases it becomes interested and cooperative. In some shops the workers have requested training in the use of the motion-time method of establishing rates.

At the Camden plant of the Radio Corporation of America every effort is made to maintain consistency in the rates established by more than 60 time study engineers. In weekly discussion groups, detailed analyses of typical operations are made, assuring that each man understands the standards and applies them uniformly.

Since 1939 more than 150 time study engineers in the Camden plant have been trained in the technique of applying motion-time standards. Several of these men have since been transferred to the Indianapolis, Bloomington, Harrison, and Lancaster plants so that consistent time study evaluation might be established throughout the entire RCA Victor Division.

Although the method of applying work factors is basically simple, the reader should not be misled into believing that all that is necessary is a table of motion times and the ability to write a description of the operation being time-studied. The whole concept of work factors can be used most successfully only by those with accurate knowledge, an analytical mind, and some engineering training.

10. What's Ahead

THE FOREGOING has been presented as an introduction to the tremendous possibilities in the field of workable motion-time standards. This is a first step. No claim is made to completeness, nor is it supposed that a final result has been attained. But it is a step in the right direction.

The scope of the motion-time formula unquestionably can be expanded and its analysis refined. Based on 10,000 observations of elemental times, it has been applied in the shop to measure 20,000,000 actual man-hours. It has been condemned, resisted, questioned, tested, accepted, and finally praised by workers, union representatives, foremen, managers, and time study engineers—more than 30,000 factory personnel in all. To date it is essentially unchanged. Compiled from observation of the daily labor of men and women in industry, it has become an accepted measure of what can be considered a fair day's work at the machine and bench. But more than this is needed. A big problem remains—and will remain until these data or similar data make it possible for time study engineers to pay identical prices throughout industry, until workers in California and workers in New York receive equal time allowances for equal work.

New Room—Better Meetings

H. P. BONCHER, General Manager, Dresser Mfg. Division, Dresser Industries, Inc., Bradford, Pa.

MANAGEMENT of the Dresser Manufacturing Division of Dresser Industries, Inc., Bradford, Pa., was aware that meetings—whether foremanship classes, safety lectures, or other staff conferences—were not yielding the definite and tangible results that should be expected from them. These meetings were being held in a beaverboard-partitioned space on the factory floor; foremen and employees sat on benches around the walls. The arrangement was makeshift, and its shortcomings were reflected in the tenor of the sessions held there.

The answer was a new conference room, smart and modern, where supervisory and factory groups can get together in quiet and air conditioned comfort.

Start of the renovation was an abandoned plant commissary. This was remodeled at a cost of $7000, only a fourth more for the "fancy trim job" than would have been spent on ordinary remodeling.

The 17x30-ft. room has wormy chestnut planking beneath the window level, broken by vertical panels of the same wood, and green leatherette walls above. Selection of the wood and of the leatherette fabric was made on the basis of ease of cleaning. The same consideration governed the choice of drapery material. A loosely woven, easily washable cloth of neutral tone was used. It is heavy enough, however, to darken the room for motion picture showings.

Much of the factory grime was kept out by sealing the eight windows cut into the walls. Heating and ventilating systems leading to ceiling anemostats were installed in the attic. The gas-fired hot-air heater was completely enclosed in a metal jacket to cut down fire hazard. From it, ducts lead to the anemostats. Arrangement of the system is such that the hot air can be filtered and recirculated through the room or fresh air brought in from the outside without the aid of the ventilating system. Temperature is controlled by wall thermostats.

A Hidden Fire Door

To take care of the need for an additional exit without detracting from the appearance of the room, a fire door, disguised as one of the windows, was constructed.

For training meetings, where the conventional slate blackboard is a customary eyesore, a special green glass blackboard was mounted in a chestnut frame on the wall.

The table arrangements of the room have contributed greatly to its flexibility. Constructed in four parts, a top, two end pieces, and crossbar braces, each table can be taken apart by two men in less than two minutes. Measuring 36x60 inches, a single table can be used for a small group, or combined with a number of others to form a conference-size table. When not in use tables are stored in cupboards in the walls of the room, which also house conference manuals and other instructional materials.

Experience has shown that these carefully planned surroundings have had a definite effect upon the conferees. There is a tendency for everyone to be more attentive and serious-minded. When shop or office men are called to a meeting in the conference room, there is a formality, which, while not overpowering, creates a quieter and more dignified mood. From a management standpoint the resulting benefit of more effective conferences and cordial employee relations has proved itself to be definitely well worth the extra cost.

Foremen hold a meeting in the new conference room

Analysis of Suggestion Award Practices

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BECAUSE the executives of Farrel-Birmingham Company, Ansonia, Conn., believed that the best way to evaluate the effectiveness of the company's suggestion system was to compare it with suggestion systems elsewhere, a letter and questionnaire requesting their experience with suggestion systems were sent to 196 firms. Of the firms that returned questionnaires, 53 submitted information complete enough to be incorporated in a report. Many companies had plans that had been in operation for less than one year, and others indicated their interest by asking for a summary.

It is to be remembered that many factors, beside the company's award practice, have a bearing on the effectiveness of a suggestion plan. Consequently, no attempt has been made to show a mathematical correlation between an award policy and suggestions received or accepted. Instead, comparisons have been made between companies obtaining excellent results and those whose results have not been so impressive.

Calculation Formula

Fifty-three of the reporting companies gave their formula for calculating the amount of the award. This information is shown in Table I.

An analysis of this table shows that 65 percent of the reporting companies calculate the amount of the award on a percentage basis of savings to the company. While it is true that the amount of award granted for a given suggestion would differ by company, depending on the general formula and the method of application, the data indicate that most companies have found it desirable to grant awards on the basis of savings.

An attempt to evaluate the liberality of the award solely on the basis of formulas would require a more detailed investigation of such formulas. It is interesting to note that the 11 companies using a net saving formula receive, on an average, 530 suggestions per 1000 employees, whereas the 8

Table I. Distribution of Companies According to Formulas for Determining Amount of Award

Formulas Used	Number of Companies	Percentage of Companies
Percentage of savings	16	30
Percentage of yearly net savings	11	20
Percentage of yearly gross savings	8	15
Amount determined by committee	13	25
Result of employee contest	2	4
Fixed amount	2	4
Determined by point system	1	2
	53	100

Table II. Distribution of Companies According to Number of Suggestions Received per 1000 Employees for 12-Month Period

Suggestions Received per 1000 Employees	Number of Companies	Percentage of Companies
1000–2000	2	4
500– 999	4	9
400– 499	5	11
300– 399	5	11
200– 299	8	17
100– 199	10	21
0– 99	13	27
	47	100

Table III. Comparison of Companies Receiving More Than 300 Suggestions per 1000 Employees per 12-Month Period With Those Receiving Fewer Than 300

Award	300 or More Suggestions	299 or Fewer Suggestions
Average highest award ever granted	$894.84	$600.28
Average of award*	11.94	18.83
Average minimum award	3.31	4.45

* Although the average of an average is not statistically accurate, it is of value for comparative purposes.

Table IV. Suggestions Accepted and Received per 1000 Employees, Acceptance Rate, Average Award, Minimum Award, Highest Award Granted (12-Month Period)

Company	Number of Suggestions Accepted per 1000 Employees	Number of Suggestions Received per 1000 Employees	Percentage Accepted	Average Award	Minimum Award	Highest Award Granted
1	680	2000	34	$26.00	$2.00	$300.00
2	260	1300	20	15.00	2.00	1500.00
3	235.6	589	40	8.00	2.00	1000.00
4	156.4	460	34	13.49	5.00	1200.00
5	149.1	497	30	4.65	2.50	400.00
6	150.5	430	35	24.00	2.50	650.00
7	148.8	480	31	8.18	1.00	200.00
8	143.6	334	43	9.87	10.00	200.00
9	140.4	390	36	15.22	2.00	2000.00
10	134.8	442	30.5	15.04	2.00	1500.00
11	131.7	399	33	16.00	5.00	500.00
12	116.3	323	36	15.22	3.00	175.00
13	115.	500	23	6.50	2.00	550.00
14	112.9	559	20.2	10.60	5.00	2605.00
15	109.9	358	30.7	16.88	2.00	1500.00
16	77.2	286	27	4.77	2.00	25.00
17	69.9	259	27	27.49	5.00	3500.00
18	62.5	250	25	.....	5.00	500.00
19	56.7	135	42	22.00	2.00	200.00
20	53.2	280	19	15.75	5.00	5600.00
21	51.5	212	24.3	9.12	5.00	150.00
22	47.9	135	35.5	6.86	3.00	500.00
23	44.9	187	24	12.81	2.00	500.00
24	42.8	175	25	74.74	1.00	458.77
25	42.0	210	20	35.00	5.00	600.00
26	40.6	140	29	19.50	2.00	350.00
27	38.7	109	35.5	12.61	5.00	241.00
28	37.5	250	15	19.00	10.00	165.00
29	37.5	250	15	.....	10.00	200.00
30	37.2	169	22	12.00	5.00	37.50
31	32.3	98	33	6.41	2.00	500.00
32	31.0	156	19.9	10.69	2.00	600.00
33	27.0	120	22.5	10.00	....	.....
34	26.3	105	25	12.00	2.00	100.00
35	25.9	69	37.5	6.21	3.00	125.00
36	20.2	48	42	16.00	5.00	270.00
37	15.9	68	23.4	26.01	5.00	500.00
38	12.5	50	25	5.00	5.00	18.75
39	10.2	85	12	32.50	5.00	600.00
40	8.3	55	15	15.00	5.00	275.00
41	7.7	22	35	9.75	3.00	500.00
42	6.3	63	10	17.00	5.00	200.00
43	3.7	23	16	16.20	10.00	37.50
44	0.7	3	24	41.28	7.50	750.00
45	0.079	0.5	15.8	25.53	2.00	500.00
Average	83.43	286.52	29.0	16.88*	4.01	733.71

* Although the average of an average is not statistically accurate, it is of value for comparative purposes

companies using a gross saving formula receive only an average of 250 suggestions per 1000 employees.

For purposes of this study, it was believed the actual dollar value of the award would have more significance than the formula used in arriving at the amount of the award. The effectiveness of a suggestion system can be determined only by (1) the extent of employee participation; and (2) the quality of the suggestions received.

Since employee participation can be best measured by showing the number of suggestions submitted per given number of employees in a given period, a distribution of companies on the basis of suggestions received per 1000 employees over a 12-month period is reproduced in Table II.

In order to determine whether there was any relationship between the amount of the award and the number of suggestions received, the 16 companies receiving the most suggestions per 1000 employees, or approximately one-third of the reporting companies, are compared with the remaining 31 companies. This comparison by group is shown in Table III.

The Acceptance Rate

Further analysis showed that the average acceptance rate of the 16 companies in the upper group was 31.7 percent, whereas the average acceptance rate of the 31 companies in the lower group was 24.7 percent.

In the final analysis, the quality of the suggestions submitted determines the effectiveness of a suggestion system. A suggestion plan must justify itself in dollars saved and in improved operating techniques. Forty-five companies submitted information on acceptance rates, which is shown in Table IV. Two companies, reporting on suggestions received, did not present this information. One of these companies had received more than 600 suggestions per 1000 employees and the other one fewer than 100 per 1000 employees.

In order to determine the relationship between suggestions accepted and the award policy of companies, the same approach was applied as in analyzing data on suggestions received. Fifteen companies, or the upper third which accepted more than 100 suggestions per 1000 employees, were compared with the remaining 30 companies, or lower two-thirds, which accepted fewer than 100 suggestions per 1000 employees. This comparison is shown in Table V.

Companies accepting 100 or more suggestions per 1000 employees received on an average 604 suggestions, as compared to an average of 137 suggestions for companies accepting less than 100 suggestions per 1000 employees. Even if the one company that reported 2000 suggestions per 1000 employees were disregarded, the upper group would still average 504 suggestions per 1000 employees. Furthermore, in the group that accepted more than 100 suggestions per 1000 employees, the acceptance rate averaged 31.7 percent as compared with 24.4 percent for the companies accepting fewer than 100 suggestions per 1000 employees.

It is interesting to observe in Table IV that every company that received more than 300 suggestions per 1000 employees had an acceptance rate of more than 100 per 1000 employees. No company that received fewer than 300 had an acceptance rate of 100 or higher.

Of the 15 companies receiving more than 300 suggestions per 1000 employees, eight, or 53 percent paid minimum awards of $2 or less while nine, or 30 percent, of the companies receiving less than 300 suggestions per 1000 employees paid minimum awards of $2 or less.

Table V. Comparison of Companies Accepting More Than 100 Suggestions per 1000 Employees With Those Accepting Less Than 100 per 1000 (12-Month Period)

Award	Companies Accepting 100 or More Suggestions	Companies Accepting 99 or Fewer Suggestions
Average highest award ever granted.....	$952.00	$623.49
Average minimum award.....	3.20	4.43

Conclusions

Companies that want to improve the effectiveness of their suggestion systems should stimulate employee participation so as to receive more and better suggestions.

Although the formulas used by companies in calculating the amount of the award to be granted differ substantially, there are relationships between the award practices of companies and the effectiveness of their employee suggestion plans. The major relationships are:

1. The granting of low minimum awards, sometimes called token awards, such as some companies offer for safety suggestions, tends to increase the total number of suggestions received.

2. The granting of even an occasional high award also tends to increase the number of suggestions received.

3. As the number of suggestions received increases, the acceptance rate tends to increase. (Part of the increase in the acceptance rate may be attributed to the granting of token minimum awards.)

4. As the number of suggestions received increases, the average award tends to decline. (Part of the decline may be attributed to the granting of token awards by companies receiving a larger number of suggestions.)

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Gate Passes Put a Stop to Unauthorized Trips

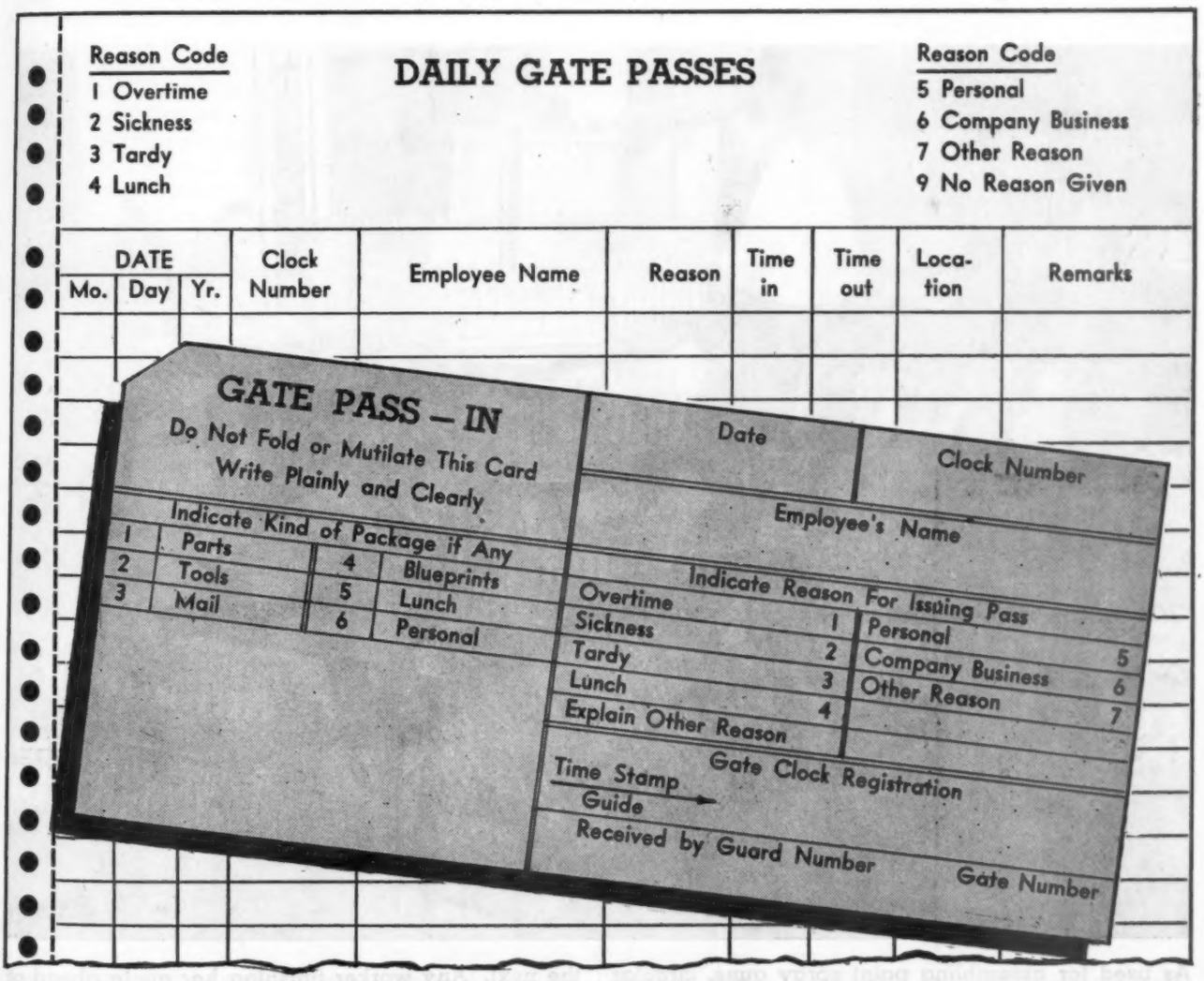
As ONE of the many steps taken to assure maximum efficiency in the employment of wartime manpower, Wright Aeronautical Corporation, Paterson, N. J., has installed a system of "gate passes" to keep close tabs on the interplant movements of employees.

The passes—red ones for outgoing trips and green ones for incoming—are made out and signed by employees each time they pass through the plant entrances at other than regular shift change time. Collected and collated, the red and green slips are recorded by tabulating machines on separate lists sent to each department head. The latter are required to study the goings and comings of their workers, and make their own follow-ups where the trips are unnecessary or unauthorized.

Two purposes are served by the system. First, by studying the passes, management is enabled to see whether or not excessive time is consumed in trips between plants—whether, in some cases, it may be possible to assign additional messengers, alter schedules, or collaborate more extensively among departments.

The second purpose is to discourage a small minority of employees who may try to upset the manpower applecart by unauthorized exits for a cup of coffee or for personal business.

On the pass cards are printed six possible reasons for the issuance of the pass (see card below). If the employee is carrying a package, there are six kinds listed that he might be expected to have—parts, tools, blueprints, and the like. Space is left for the date, the worker's name and clock number, gate clock registration stamp, guard's number, and gate number. Copies of the departmental lists are kept in the plant protection manager's office, for checking on personnel whose movements are in doubt.



Gate passes are issued for all necessary trips from one plant to another at Wright Aeronautical Corporation, while the daily summary of passes given out helps supervisors keep track of workers

Revolving Tables for Lower Assembly Cost

W. J. TILLMAN, Standards Department, The DeVilbiss Company, Toledo

USE OF REVOLVING TABLES for assembly operations at The DeVilbiss Company, Toledo, has brought about a number of marked savings, compared to motionless horseshoe-shaped and rectangular tables that previously were used. Less space is required for the revolving tables, which are circular; less fatigue of workers is caused; and greater output of products is obtained.

Some of the increased output and other benefits are credited to an individual incentive wage plan adopted when the revolving tables were installed. Previously, with the horseshoe tables, a group incentive system was the only type that seemed to be practicable.

Rate of production per worker has been found to run about 20 percent higher with the revolving tables than with the horseshoe type, and the latter were also an improvement over the rectangular tables. While the advantages of the revolving tables might not be the same for assembling a single product, made continuously, the benefits of the new system at DeVilbiss, where small products are assembled in a rather rapidly changing variety, have been impressive.

Originally the company used rectangular tables for its assembly operations, but obtained a number of improvements when it installed the horseshoe tables ("New Assembly Layout—20 Percent More Output," FACTORY, June, 1942, page 88). At the time it changed to horseshoe tables, it already had one rotating table in operation on an experimental basis. There was insufficient evidence then,

As used for assembling paint spray guns, circular revolving table provides shelves that serve to move materials or subassemblies from one operation to the next. Any worker finishing her quota ahead of others is free to shift to another circle, getting credit for production in both places

however, to tell whether the rotating tables would be an improvement.

Subsequently, the experimental revolving set-up did work out satisfactorily, with marked savings in floor space in addition to the increase in output. As a consequence, assembly line technique was changed over to the revolving table type, and now it is practically universal in DeVilbiss assembly departments.

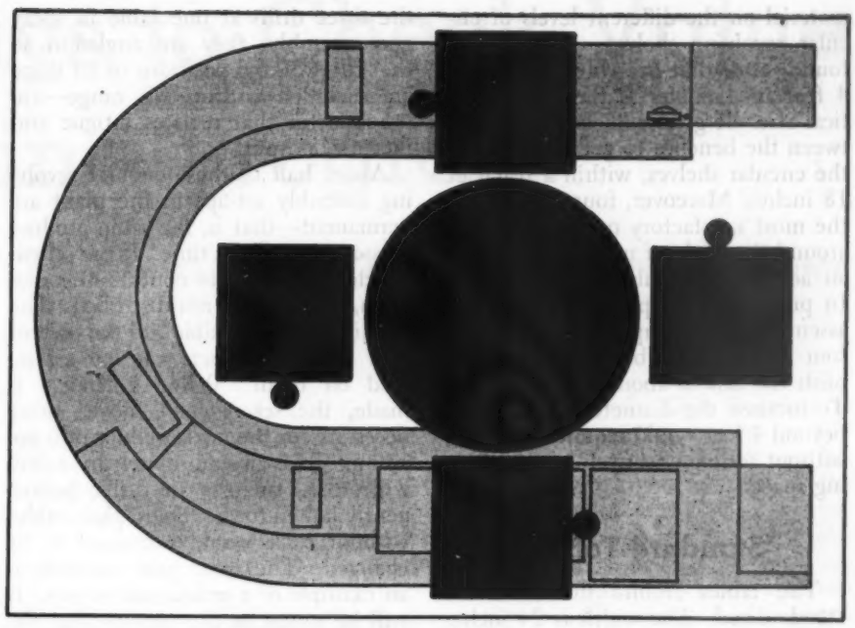
Perhaps some features of the revolving assembly table technique will be more easily understood if certain aspects of the processing of the products are stated. First it should be noted that the products are small; moreover, they are made up of a number of individual parts and subassemblies which must be handled carefully to prevent injury to finish or function. The model of a product from engineering is, by the methods department, reduced to subassemblies.

The determination of which parts of the product shall be a subassembly, and which shall be an individual part in the final assembly, is based upon several factors. Service parts sold as replacements are one factor, subassemblies interchangeable on many product types are another, and the productive hours required in final assembly which must balance out among the requirements of the various subassemblies are a third. Injury to subassemblies by handling to and from the stockroom must, of course, be considered.

Many Diverse Steps

The progress is, then, from parts in stock to subassembly back to stock and then out for assembly into a major subassembly; then back to stock and out again with individual parts to final assembly. The complete product assembly cannot be done in one step because of the interchangeability of parts and subassemblies among final products, and the varying demand for these products.

The accompanying contrasted layouts illustrate the difference in space requirements between these two assembly techniques. The horseshoe requires a minimum of 2 feet all the way around the table for delivery of stock to and from the operations, whereas racks containing parts and subassemblies may be wheeled from the stockroom and placed adjacent to the operators, and within the circumference formed by the outer edge of the tables placed around the revolving table. The set-up illustrated is for the assembly of one type of spray gun, and is typical of the many in operation. It is to be noted that theoretically the same work is done on the circular set-up in a space of 8x8 feet as is done on the horseshoe in a space 8x12 feet. Practically, however, the exact space will depend upon specific location in relation to other operations, to building columns, and to aisleways.



New revolving table layout in black is superimposed on old horseshoe-shaped layout to show the worth-while saving in floor space

In addition to space saving, an individual incentive payment is possible; with the horseshoe a group plan was necessary. Individual incentives also helped increase output, but how much is due to individual payment and how much to the circular table is difficult to say. The spray gun assembly group, however, earns some 15 percent above that earned when the same group worked on the horseshoe. The circular shelves of the revolving table serve to move the material from one operation to the next, and hold a bank of parts between operators. One operator is not, therefore, held back by the output of the preceding operator. A counter is placed at each workplace, and when the operator has completed her operation on the lot she may shift to another assembly circle and be credited for her production on the first circle. This bank of parts, and freedom to move from one circle to another upon direction by the foreman, makes the problem of balance in a group much less difficult.

In the horseshoe, the workers find it necessary to move about the inside of the curve. This leads to interference and talking, which affect output adversely. In contrast, the positions of the workers around the circular table completely eliminate this interference, because tasks are separated on individual tables and there is no occasion for any one to walk around someone else to get to the job. Around the circular assembly table, also, one worker has his back to the other, or the table is between them. Talking is not, therefore, as likely to interrupt output.

When the circular assembly tables were first put in workers objected because their positions interfered with talking. However, all kinks were worked out with the first experimental table, in atomizer assembly, before others were installed, and when it was evident to the workers that they could earn considerably more money the objection disappeared. Succeeding installations met no objection at all.

Less Lifting, Less Fatigue

Less handling of material between operations is required with the circular set-up, because movement between operations is done by the revolving shelves on the circular table—which means reduced lifting and less fatigue.

The experimental circular assembly table had workers at different levels, on platforms, around the circle to correspond to the level of the revolving shelves. This was a mistake. It was soon realized that it constituted a safety hazard, and that output was affected by the fear of falling. All operators were then placed at floor level, and succeeding installations were made in the same way.

Individual benches around the circle now are 28 inches high, or 32 inches if standing is necessary for the operation, to permit easy reach to the

material on the different levels of circular revolving shelves. It has been found, also, that a revolving table of 4 feet in diameter is the most practical size. It gives sufficient room between the benches to get to and from the circular shelves, within a reach of 18 inches. Moreover, four workers are the most satisfactory number to place around the circle; if more are required, an additional circular unit is set up. In processing the part, however, subassemblies are set up on the basis that four workers will be able to accomplish the task in about the same time. To increase the diameter of the circle beyond 4 feet would require more area without adding effectively to the working space.

Standard Tables

The tables around the circle are standardized. The width is 24 inches and the length varies from 24 to 42 inches in steps of 6 inches—the length depending upon the number and kind of operations at each assembly center. One may require three drilling operations, whereas another may use only a power screwdriver. The width of the tables is kept at 24 inches, because operators should not reach beyond 18 inches, the limit of a forearm movement. This width allows space for toteboxes where needed—sloped, incidentally, 30 degrees to bring parts to the same spot—and for whatever power tools may be required, without getting beyond the 18-in. reach. The working area is arranged so that the operators do not have to cover a space larger than 6 inches square in eye direction. If tools are required, such as the three drills at one table in spray gun assembly, they are angled-in so that the working positions of all three are included within this range—another factor that reduces fatigue and increases output.

About half of these circular revolving assembly set-ups in the plant are permanent—that is, the same product is assembled all the time. If the schedule does not require continuous operation, the set-up is not disturbed. The remainder are flexible to the extent that several products can be assembled on them. When a change is made, the set-up man moves those necessary for the next product into position. This would apply to tables with tools, such as air drills, permanently bolted to the tables; plain tables without tools would not need to be changed. The spray gun assembly is an example of a permanent set-up. It will be noted in the picture that the revolving shelves in the circular table are fitted out to hold each gun in position, separated from every other gun; it could not, therefore, be used for a different product.

Perhaps a detailed description of the operations on the spray gun may serve to clarify some of the differences between the horseshoe set-up and the revolving assembly table.

A rack is brought from the stockroom with the gun bodies and placed at the No. 1 assembly position on the revolving table. The first operator takes the parts from the stock rack, performs three drilling operations, and puts the part on the lower circular shelf about 18 inches to her left. At the No. 2 position the operator takes the part from the lower shelf and performs a ream and face operation—behind the first operator, and done in a standing position with the tools under a hood. The second operator returns the part to the second circular shelf. At the No. 3 position, which is on the opposite side of the circle from No. 1, the operator assembles the valve to the gun. At the fourth and last position, the operator assembles the valve for the third operator, which is placed in holes on the outer circumference of the second circular shelf, and assembles the draw bar and trigger to the gun taken from the third circular shelf. From the fourth position, the assembly is placed back on a special rack for delivery to the stockroom. Any operator can revolve the circular shelf as needed to locate empty spaces for his or her production.

Higher Bonus

When the gun was assembled on the horseshoe tables, operators made 125 percent over the base standard set by time study; with the revolving assembly table, they make 140 percent over the same base. It must be remembered that not one product is assembled, but many products with varieties of each. Moreover, interchangeable parts and service parts make it necessary to assemble parts into subassemblies, and then into major subassemblies, before the final product is put together. Transporting to and from the stockroom is therefore frequent and necessary. It is not contended that the circular set-up is the proper one to use for a single product made continuously, but for conditions like those at DeVilbiss it is ideal.

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Paper is a Number 1 war material shortage—because over 700,000 different *war* items are wrapped, packaged, labeled, tagged, or made from paper or container board. The Pacific war, when it speeds up, will require stupendous amounts of paper and board since double and triple packing are required for protection of war materials against weather and insects. So please—

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DO THIS EXTRA BIT TO HELP

Eight Ways to Check Value of Training Program

C. H. LAWSHE, JR., Division of Education and Applied Psychology, Purdue University, Lafayette, Ind.

RIGHT NOW, when reconversion to peacetime operation is in the mind of management, many of the "frills" of a war era are being scrutinized, and training activities, which have enjoyed a growth unprecedented in the history of industry as a result of the demands that production needs have placed upon management, are no exception.

Many training departments that have done a good job will have not one shred of evidence to point to their excellence. The purpose of this paper is to present concretely a number of techniques that have been used in industry to answer the question, "Has our training been effective?"

1. Increased Production. Most convincing of all, of course, is the production yardstick. How many pieces, how many units, how many tons are we getting per man-hour?

Figure 1 presents data[1] from a plant engaged solely in the process of making diamond dies, which are in turn used in the extrusion of fine tungsten wire for vacuum tube filaments. Time intervals of two months each are indicated in bimonthly units on the baseline of the graph. Values on the vertical axis indicate units of production per man-hour, expressed in terms of average production before training.

For the four months studied before training (September to December) average production per man-hour was constant, and is called 100 percent. About the middle of November the company started to hire new employees who were taken through a systematic job training program. At the same time, old employees were retrained. New hiring continued throughout the study, but the old employees had been trained and the job breakdown completed by the middle of February. By that time, production per man-hour had increased about 35 percent, and, as the months continued, production increased to a point approximately 43 percent above the original level. In the period of time included in the study, the number of employees more than doubled.

The methods and standards departments in many plants have devised various indexes of production for particular jobs or operations. Figure 2 utilizes one such index called the "production performance percentage." In short, this value represents the relative proportion of an established standard which an employee produces in the operation of a machine for cutting thin disks from nickel-tungsten rods.[2] The horizontal dotted lines on the graph represent the average performance of three groups of old employees averaging 9, 5, and 2 months' experience on the job. The curve shows the average production of 19 new employees, beginning with their first week of employment and continuing through 12 weeks.

Every experienced production man knows that there are great individual differences in the job-performance of even experienced employees. Figure 3 presents data[3] from a steel mill involving the training of substandard rollers and crews. The vertical axis carries a production index known in this plant as "budgetary control performance." As is indicated by the horizontal arrow, the previous average of all rollers was 75, while the previous average of the substandard group segregated to be trained, was 67. The weekly average of each group is plotted for the 12-week period during which the substandard group received training. While production irregularities of all kinds are reflected in the two curves, there is an unquestionable upward trend in the curve of the trainees, indicating consistent improvement.

2. Reduction in Time Required to Do the Job. Efficiency on certain maintenance and service jobs can frequently be measured in terms of the time required to do the job. Likewise, the effects of training may be evaluated by comparing the average time required before and after. As is shown in Figure 4, the average time required to change the blades on flying shears[4] was 29 minutes for the one-year period immediately prior to training. Average times for 4 months before the training began are plotted, and averages for 8 months after training started also are shown. The average after July is approximately 17 minutes, or only about 58 percent of the former time. According to the company's own testimony,[4] this time reduction resulted in a labor saving of $1740 per month, or $20,880 per year, to say nothing of the saving from reducing the downtime of the machines.

3. Increase in Number of Operators Who Meet Standard. Where production standards have been establshed by the methods department, and where individual production records are maintained, the percentage who attain or exceed the standard provides one measure of group efficiency. The comparisons presented in Figure 5 utilize such a measure. The employees are engaged in record press operation, for which standards have been established. The training program was an "orientation" or "induction" program of a non-job nature. A group of 115 beginners were utilized in the study. Sixty-seven had not participated in the program; 48 had been enrolled. In both groups employees remained on the job a minimum of 90 days. An examination of individual production records indicated that during the first 4 weeks of employment 22 percent of those in the program met the standard one or more weeks, while only 16 percent of those not in the program met it. A similar analysis was made for the

[1] C. H. Lawshe, Jr. "Training Operative Personnel," *Journal of Consulting Psychology*, 1944, Vol. VIII, No. 3 (May-June), 158.

[2] L. G. Lindahl, *Movement Analysis as an Industrial Training Method*. Unpublished Ph. D. Thesis, Purdue University Library.

[3] R. J. Greenly, "Job Training," *National Association of Manufacturers Labor Relations Journal*, 1941, No. 35, pp. 5-8.

[4] Joseph Tiffin, *Industrial Psychology*. New York: Prentice-Hall, Inc., 1942.

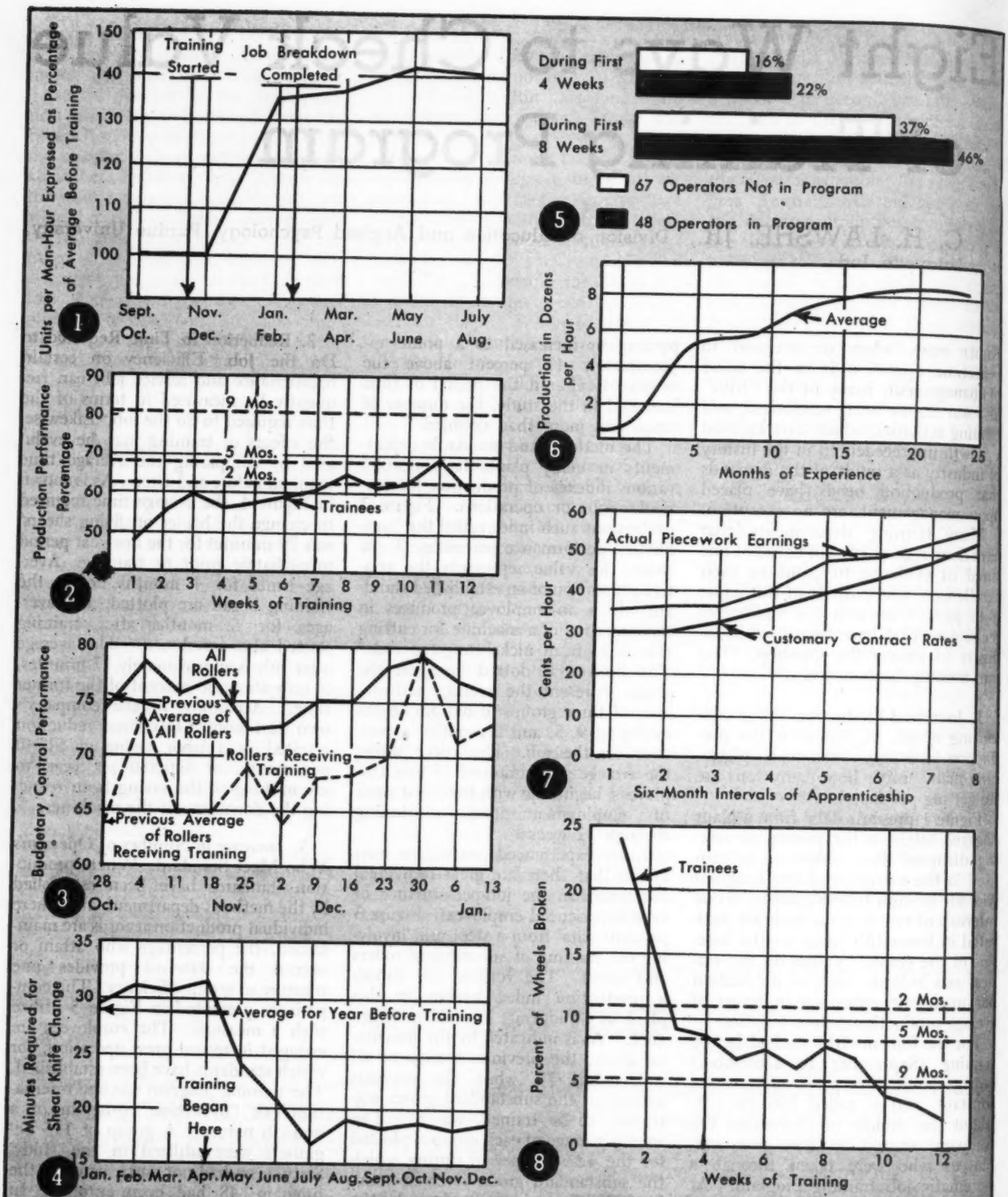


Figure 1. Effect of systematic job training program on output per man-hour in manufacture of diamond wire dies . . . Figure 2. Production of disk cutter trainees compared with that of three groups of experienced operators . . . Figure 3. Effect of training program on production of rollers and crews in a steel mill . . . Figure 4. How training affected time required to change knives on flying shears . . . Figure 5. Effect of orientation program on proportion of employees who met standard one or more times during first four and first eight weeks of employment. . . . Figure 6. Learning curve plotted from average number of dozens of hose looped per hour by 199 employees in a hosiery mill . . . Figure 7. Learning curve plotted from average piecework earnings of 75 machinist apprentices for eight 6-month periods constituting apprenticeship . . . Figure 8. Reduction in breakage of abrasive wheels by 19 trainees during training period. Dotted lines indicate percentage broken by experienced operators

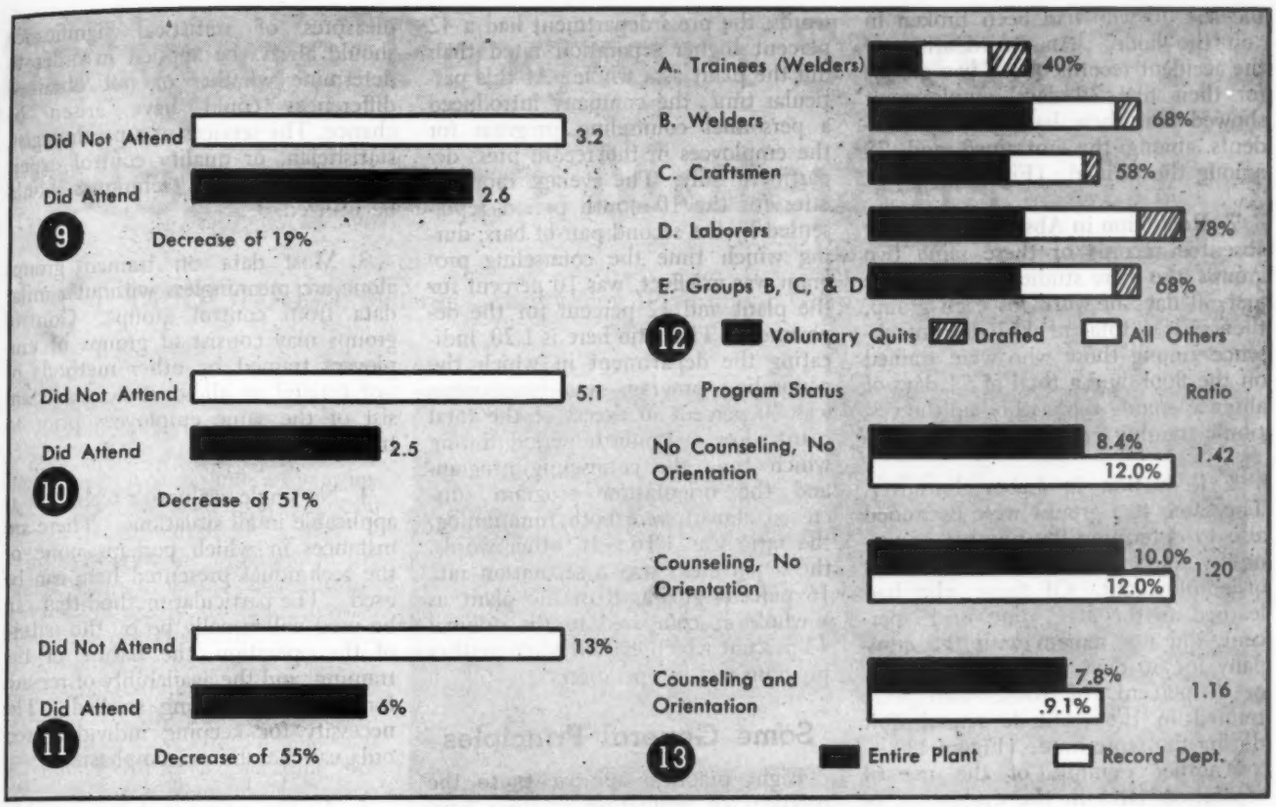


Figure 9. Average number of injuries per day for first 30 days of employment of 70 beginners who attended a vestibule training program and of another 70 who did not attend . . . Figure 10. Average number of daily absences during first 30 days of employment of 70 beginners who attended vestibule school and of 70 who did not attend. . . . Figure 11. Percentage of separations during the first 30 days of same 140 workers . . . Figure 12. Percentage of four groups of shipyard employees who quit during a 6-month period . . . Figure 13. Graph showing the average monthly separation rates for an entire plant and for a particular department during periods when no program was functioning in the department, when only a counseling program was functioning, and when both programs were in operation

first 8 weeks of employment for each operator. A greater proportion had met the standard in each group, but the same differential, represented by 37 and 46 percent, remained.

4. Increase in Learning Rate. Training effectiveness may be reflected in an increased rate of learning on the job. Learning in this sense may be measured in terms either of production or of earnings.

Figure 6 shows the average production in dozens per hour for 199 loopers[4] in a hosiery mill, plotted against experience on the job. Should a new or different training program be inaugurated, similar data for the trainees could be secured and the trainee curve superimposed over this one. Any significant differences in rate of learning would then be apparent.

Figure 7 presents the average piecerate earnings of 75 machinist apprentices for eight 6-month periods. This is an example of a learning curve plotted from wage data which reflect production. Should this company make any changes in its apprenticeship training program, which it would like to evaluate against the present plan, a similar curve based upon the earnings of new apprentices who had been trained by the modified method could likewise be superimposed.

5. Decrease in Breakage or Use of Consumable Supplies. Inexperienced employees frequently break larger quantities of drills, tool bits, and similar consumable supplies than do more experienced employees. One method whereby the worth of a training program may be evaluated is through a study of such supply figures. Figure 8 is a case in point. The nineteen operators whose performance is plotted in this figure are the same trainees described in the disk-cutting operation.[5] In the cutting of these disks, 6-in., rubber-bonded, abrasive wheels are used. Breakage of these wheels is expensive; furthermore a broken wheel means a shutdown to remove broken portions of the wheel. The graph shows the percent of wheels broken on the vertical axis and weeks of training on the horizontal axis. The three horizontal dotted lines indicate the average percent of breakage of old employees averaging 9, 5, and 2 months' experience, respectively. During the first week of training, the trainees broke 24 percent of their wheels. Gradually the percentage fell off, however, until during the fourth week they broke no more wheels than the employees with 5 months' experience; and at the close of the period covered by the study, they were breaking fewer than employees who had been on the job 9 months.

6. Reduction in Number of Accidents. All the above approaches to the evaluation of training programs employ production records. Accident records, absentee records, and separation rates also are oftentimes a key to evaluation. In one plant, a vestibule training program was instituted for employees who were to operate certain simple machines. For purposes of this study, the first 70 persons to attend the school were compared with

[5] L. G. Lindahl, see footnote 2.

the last 70 who had been broken in "on the floor." An examination of the accident records of the two groups for their first 30 days' employment showed that there had been 96 accidents among the untrained and 78 among the trained. (Figure 9).

7. **Reduction in Absenteeism.** The absentee records of these same two groups also were studied. During the first 30 days of work for each group, there was a total of 152 days of absence among those who were trained on the floor, and a total of 74 days of absence among those who had the vestibule training. (Figure 10).

8. **Reduction in Labor Turnover.** The same two groups were examined also to determine the number of voluntary quits within the first 30 days of employment. Of those who had learned on the floor, nine, or 13 percent, did not remain with the company for 30 days, whereas only four, or 6 percent, of those who were trained in the vestibule school quit during the same time. (Figure 11).

Another example of the use of separation rates in the evaluation of training is presented in Figure 12. Fifty shipyard welders who had just completed a training program were selected for study.* At the same time, 50 journeymen welders, 50 miscellaneous craftsmen (machinists, maintenance men, etc.), and 50 laborers were selected at random. At the end of the next 6-month period, the separation rates for each of these four groups were computed. As shown in Figure 12, 40 percent of the trainees left the company, while 68, 58, and 78 percent respectively, of the other three groups, or 68 percent of all the non-trainees, were no longer with the company. The bars in this figure are broken down to indicate the relative proportion of "voluntary quits," those drafted, and those who left for all other reasons. Significant is the fact that the number of voluntary quits was only about one-third as great among the trainees.

In studying separation rates as they are related to training, seasonal fluctuations sometimes mask the real differences that exist. In one plant, the press operators above constituted a single department which had a separation rate in excess of the total plant rate. The respective rates for the total plant and for the department were 8.4 and 12.0 percent, as indicated by the first pair of bars in Figure 13. For this 3-month period the ratio between the two rates was 1.42; in other words, the press department had a 42 percent higher separation rated than did the plant as a whole. At this particular time, the company introduced a personnel counseling program for the employees in the record press department only. The average monthly rates for the 10-month period represented by the second pair of bars, during which time the counseling program was in effect, was 10 percent for the plant and 12 percent for the department. The ratio here is 1.20, indicating the department in which the counseling program was functioning was 20 percent in excess of the total plant. For a 2-month period during which time the counseling program and the orientation program (discussed above) were both functioning, the ratio was 1.16. In other words, the department had a separation rate 16 percent greater than the plant as a whole as compared to the original 42 percent which existed when neither program was in operation.

*"Analysis Showing Effect of Training on Turnover," War Manpower Commission, Bureau of Training, Jan. 1, 1944.

Some General Principles

Eight practical approaches to the problem of evaluating training have been presented; there are many others but these will serve to illustrate that training effectiveness can usually be measured in some way. There are a number of general principles that should be kept in mind:

1. The more varied and versatile the training activities in a particular plant, the more difficult it is to evaluate the training program as a whole. In general, evaluation must be specific in terms of a particular training problem, department, or course. One or two well-chosen examples will frequently show that the training department is making money.

2. The more employees involved (within limits), the more reliable will be the differences obtained. Standard measures of statistical significance should always be applied in order to determine whether or not obtained differences could have arisen by chance. The services of a psychologist, statistician, or quality control expert trained in statistical techniques should be utilized.

3. Most data on trained groups alone are meaningless without similar data from control groups. Control groups may consist of groups of employees trained by other methods or not trained at all, or they may consist of the same employees prior to training.

4. No single evaluative technique is applicable in all situations. There are instances in which perhaps none of the techniques presented here can be used. The particular method that can be used will usually be by the nature of the operation, the nature of the training, and the availability of records for the groups being studied. The necessity for keeping individual records can not be overemphasized.

5. To the extent that it is possible, such factors as age, sex, color, and experience should be controlled. In other words, when comparing two groups, be certain that there is not a preponderance of women in one group and of men in the other. Sometimes it is necessary to discard the records of a few employees to make the groups more nearly comparable.

The final answer as to whether or not a particular training activity has been profitable cannot be answered wholly in terms of analyses. A particular production increase may seem significant. However, the results must be balanced against the cost of the training activity, the union's attitude toward it, and the many other factors that every industrial relations or training man has learned to respect.

THE AMERICAN WAY

Post-war factory management must assume the responsibility for speedy, efficient reconstruction of our national industrial machine, and all of us engaged in factory management must now recognize the urgent need for establishing high levels of productivity and employment as quickly as may be possible in the post-war period . . . Increasing wages provide management with a compelling incentive toward increased mechanization. In the absence of improved productive efficiency, arbitrary wage increases, arbitrary reduction in working hours and decreased productive effort on the part of the workers will lead simply to increased costs and reduced living standards.

Louis Ruthenburg, President, Servel, Inc.

Salvage Program Saves Money and Materials

A. J. McDONALD, Material Conservation Department, Goodyear Aircraft Corporation, Akron

METHODS of materials conservation have become practically a science in the plants of the Goodyear Aircraft Corporation, Akron, and are an important factor in lowering production and maintenance costs.

The success of the program, in the opinion of Goodyear management, has been due primarily to the extensive nature of its operations and to the fact that although it was departmentally organized, it has a centralized control.

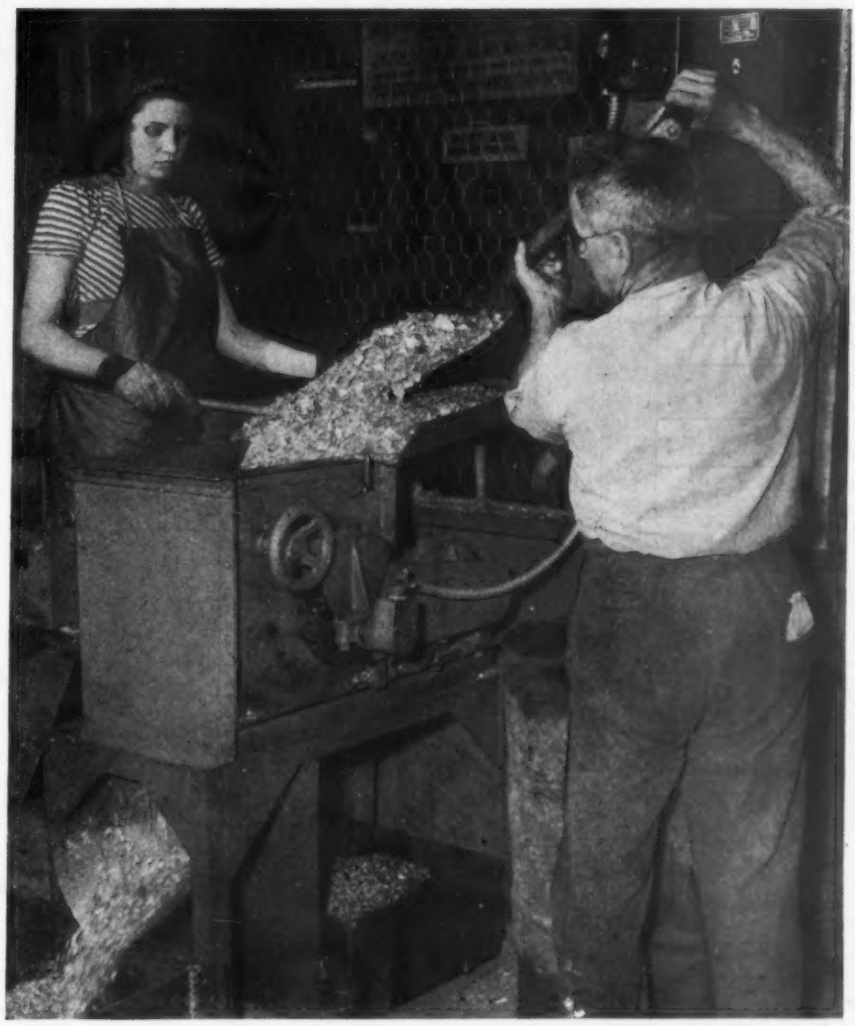
The size of the problem that this program tackled grew rapidly between 1940 and 1943, even exceeding the rate at which the company itself grew from 100 employees to more than 34,000. The problem's growth was the faster of the two because it resulted in part from the inexperience of thousands of the new employees who had been hastily recruited from the ranks of farmers, beauty operators, salesmen, housewives, and others who were entirely new to manufacturing methods.

Controlling Waste

There were bound to be left-over materials. Mistakes were inevitable and, with unskilled labor and untrained supervision, it was apparent that excessive quantities of material would go to waste if not properly controlled. The solution certainly was not a crew of janitors, a dump truck, and a rubbish lot. The company had become too large, the losses would have been too great. Organized conservation had become a crying need.

It was deemed of prime importance in organizing a good conservation program to obtain the interest and cooperation of the workers and supervision. To do so, committees were organized including management, labor, maintenance, engineering, and Army and Navy representatives. By advertising the necessity for conservation through posters, billboards, and the company's house-organ, the employee came to realize that waste was costly to the war effort as well as to the company, and that conservation was to be accepted as part of his job.

Following in the footsteps of the Goodyear Tire & Rubber Company, which many years ago developed successful materials conservation in its operations, the Goodyear Aircraft Corporation took many fundamental policies from the parent company. Experience taught the importance of having a well-organized department devoting its time and efforts to the elimination of unnecessary waste and wasteful practices, and to conserving items needed in production.



All floor sweepings go through a magnetic sorting machine which separates steel parts, dust and lint, rubbish, paper, and small aluminum parts. Containers are of different colors, to aid identification

There are many distinct functions that such a department must perform in order to operate efficiently:

1. Collect all the scrap.
2. Set up byproducts division.
3. Dispose of all surplus and obsolete material.
4. Salvage all possible usable material from scrap.

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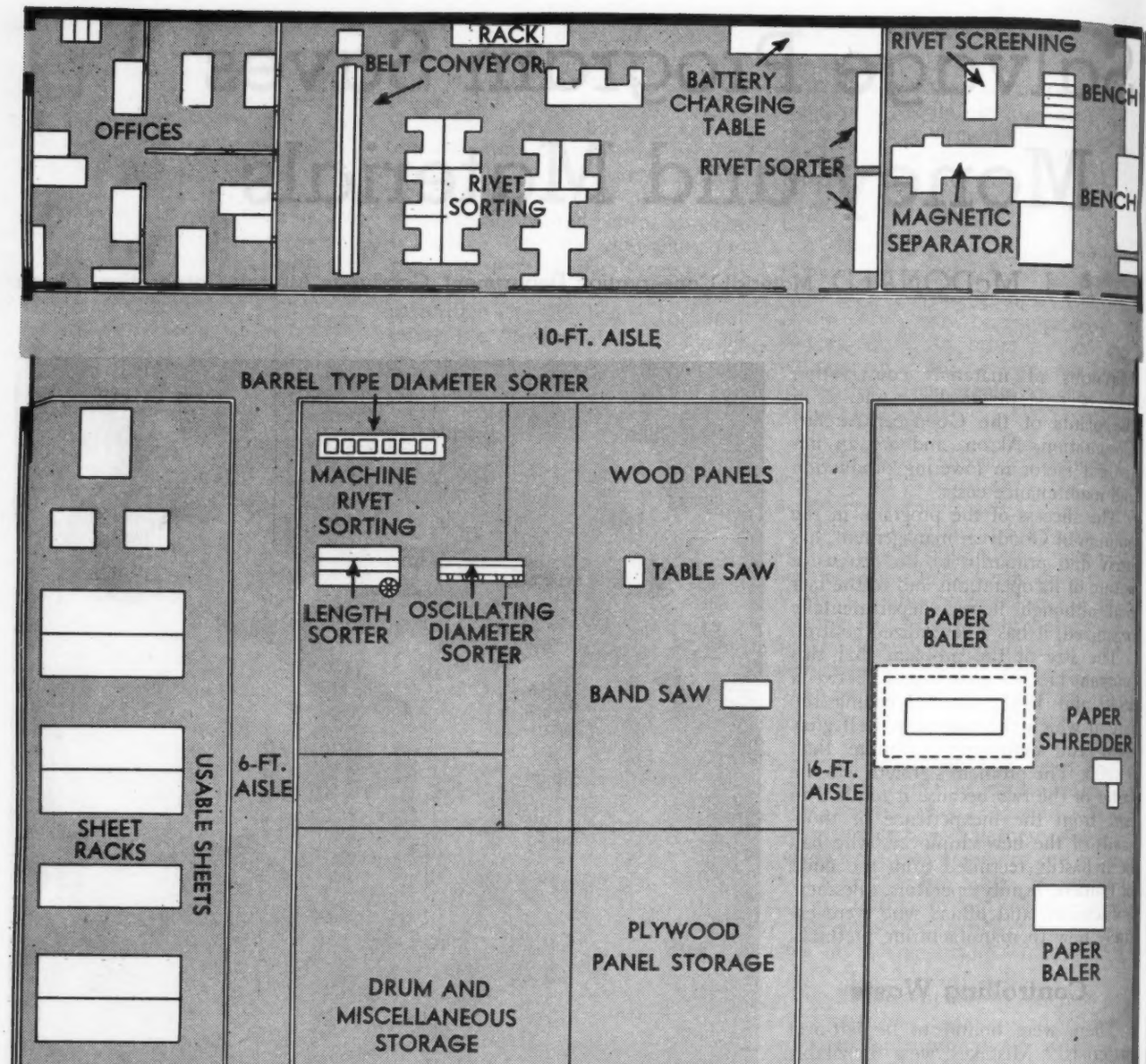

RACK
BELT CONVEYOR
BATTERY CHARGING TABLE
RIVET SCREENING
BENCH
OFFICES
RIVET SORTING
RIVET SORTER
BENCH
MAGNETIC SEPARATOR
10-FT. AISLE
BARREL TYPE DIAMETER SORTER
MACHINE RIVET SORTING
WOOD PANELS
TABLE SAW
LENGTH SORTER
OSCILLATING DIAMETER SORTER
PAPER BALER
BAND SAW
PAPER SHREDDER
6-FT. AISLE
6-FT. AISLE
USABLE SHEETS
SHEET RACKS
PLYWOOD PANEL STORAGE
PAPER BALER
DRUM AND MISCELLANEOUS STORAGE
ALLIGATOR SHEAR
PLATFORM SCALE
SHEAR
10-FT. AISLE
24 S BORINGS
STORAGE OF BALED ALUMINUM
METAL PRESS
SCRAP ALUMINUM
PLATFORM SCALES
MOTOR
14 S BORINGS

A central salvage plant is equipped with a wide variety of machinery for recovering salvageable materials, and is laid out for rapid, departmentalized handling. As far as practicable, every process is mechanized

←

5. Prepare scrap material that cannot be utilized to receive the greatest dollar recovery from its sale.

6. Enlist the cooperation of production engineers, production planning, and the various production departments in the plant.

7. Organize a factory-wide educational program to impress everyone with the importance of conserving various metals.

8. Encourage good housekeeping.

9. Follow the directives of government agencies, such as Army, Navy, WPB, and OPA.

10. Keep all necessary records and charts for a complete control of the program.

A branch materials salvage department was created in each plant, all reporting to a centralized department. Each branch is the "watch dog" of its plant, to avoid unnecessary waste.

Collection drums are provided throughout the plant, conveniently located to collect waste and scrap materials. Colors painted on the drums show their specific purpose. For example, a drum painted orange is for aluminum only, brown denotes steel, and black stands for waste and rubbish.

Segregation of aluminum scrap has run between 96½ and 98½ percent to the specification analysis. This has been aided by excellent cooperation of production supervision in the segregation of waste materials at the source. All drums are inspected when they are received in the materials salvage department and graded either good or bad. This report is given daily to the production supervision.

In the wheel and brake division, magnesium scrap must be separated according to alloy, and dry and oily chips must be kept separate. Another critical item in this division is cast-iron chips. They are used in controlling the magnesium fires, which are quite frequent. After the fire is extinguished with cast-iron chips, the mixture of magnesium and cast-iron chips is shoveled up and put through a magnetic separator which sorts out cast-iron chips for the control of future fires.

Except for magnesium, because of the fire hazard, the drums of materials are sent to the central salvage building, a unit devoted entirely to specialized equipment designed to handle salvage rapidly and efficiently. Here, usable pieces are stored. Scrap is cut when necessary and pressed into 25-lb. briquettes. Floor sweepings are put through a magnetic sorter which separates the accumulation into five classes —steel parts, dust, rubbish, paper, and aluminum. This one machine is capable of taking care of all floor sweepings for all plants in one 8-hour shift.

An analysis for a typical month shows that out of 23,964 pounds of floor sweepings, 5257 pounds of aluminum rivets, 2492 pounds of mixed aluminum, and 4794 pounds of mixed steel are reclaimed.

Two paper balers are used to take care of all the paper picked up in the plants. Paper bearing confidential matter is put through a shredder before it is baled. Paper scrap collected in a typical month includes 99,822 pounds of corrugated paper, 124,082 pounds of mixed paper, and 9526 pounds of kraft paper — 233,430 pounds in all.

Cast-off lumber is gathered from all plants and is cleaned up and put back into use. For example, cast-off pieces of plywood are retrimmed, and used to make aluminum packaging cases.

Sorting Rivets

A sizable saving has been effected by a rivet sorting section consisting of four machines—one for sorting and removing small pieces of aluminum scrap from rivets, one for sorting by diamater size, another for head type classification, and the fourth for length. Three operators can handle the daily flow of mixed rivets with ease. To reduce the mixing of rivets on the production lines, reclaimed rivets are packaged in cellophane bags in small, reclassified lots.

Another machine sorts bolts and various hardware. Straightening bent drills and putting them back into production is another salvage operation. One man is kept busy on this operation alone. Weak dry-cell batteries are recharged.

In cooperation with the local Society of the Blind, the company has been able to employ a number of blind workers in the salvaging of special rivets and hardware not sorted on machines. On certain operations, they are able to make a satisfactory separation through their sense of touch.

An important operation is the shearing of salvaged scrap to be returned to production. A shearing machine is kept busy 8 hours a day. In a typical month the salvage of aluminum amounts to 104,235 pounds.

Mere segregation of byproducts for re-use or sale was not considered nearly enough. Avoidable waste of materials had to be stopped at the source. To that end, waste control sections were created in all plants, and thousands of dollars are saved monthly, in each plant, through the innovations and suggestions coming out of these sections. A materials salvage recommendation form is used by the waste control sections to bring recommendations for changes to the attention of the process engineers.

Converting Scrap

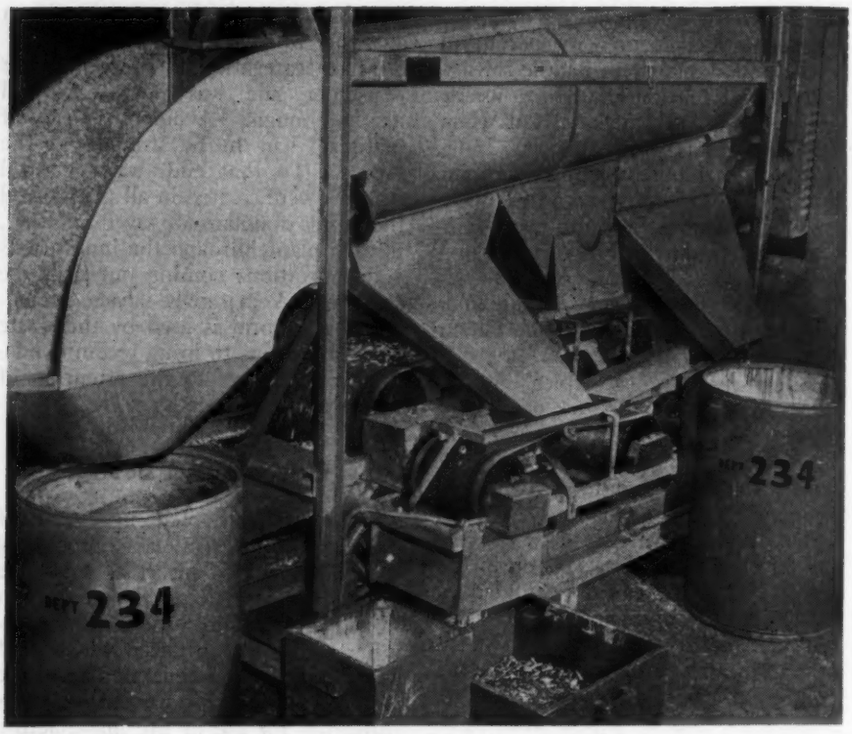
Among the accepted suggestions of the waste control section is a processing step whereby two pieces of scrap are welded into a single piece large enough to be stamped into a useful part. Another saving was achieved when what was formerly scrap generated from the production of airship car channels was converted for use in the manufacture of leading edges on airplane tail surfaces. Savings on this job alone were better than $2000 monthly and this is but one of the numerous products to which such a process can be applied.

This department discovered that specifications on many blueprints called for pieces to be cut with the grain of the metal. Realizing that this condition was not universally necessary, it arranged with the engineering department to cut pieces without regard to the grain wherever possible. An increase of 50 percent more parts per sheets of aluminum has been the result because it is possible to "nest," which means changing the position of the dies in order to utilize the materials more economically.

The amount of scrap saved by nesting is tremendous.

Other ideas include transferring galvanized sheet, not usable by the photography department, to the engineering department for lofting purposes, and making engine cowlings by welding scrap pieces together. Because of such thinking, waste of materials has been appreciably lessened. It is the waste control department's job to devise methods of preventing waste and salvaging byproducts.

The systems of conserving have been developed even further in parts manufacture. Not only is it required that all process sheets for parts be routed through salvage storerooms prior to taking sheets of raw stock, but scheduling of parts through the shop also is required in accordance to predetermined layouts. Such layouts utilize sheet stock more efficiently be-



Cast iron chips, used to control magnesium fires, are recovered by running the subsequent mixture of metal chips through a magnetic separator. Thousands of dollars are saved monthly by Goodyear Aircraft Corporation's comprehensive conservation program

cause patterns have been drawn to show the best combination of parts that can be obtained from a sheet so that a minimum of aluminum remains after the cutting operations.

This waste control program has proved a success beyond the shadow of a doubt. The quantity of rubbish reaching the dump is insignificant. Dollars spent on conservation are but a small part of the savings effected in materials. Orderliness has been created. Workmen have been made conscious of wasteful methods, and supervisors are aware of their responsibilities to guard against waste. The over-all picture of production has been made neater and more efficient by the conservation program.

Saving the Pieces

To prevent the possibility of a rejected or obsolete manufactured part being scrapped without authority, all rejected parts from subassembly, assembly, shears, routers, drills, drop hammer, and so on, are first delivered to the salvage engineer who makes every effort to save such material through rework, deviation, or engineering change. If the parts cannot be saved, they are stamped "scrap" and placed in a designated place for pick-up by a waste control representative, who checks each part for the scrap stamp mark. Items having removable parts, such as assemblies and castings with bearings, are routed to the materials salvage building where they are dismantled and the good parts returned to stock after an authorized inspection has been made.

The waste control department also constantly patrols the plant, watching for waste of every nature, even to checking the unnecessary use of electric lights. The patrolling includes keeping aisles clear of trucks or skids loaded with material in such a manner that it could be injured or damaged. Departments are watched for careless handling of tools by workers or tools lying around in such a position that they might be knocked to the concrete floor and damaged.

However, it became apparent as production rolled into high gear that all these things still were not enough. Inventories in all plants were going up too rapidly. It was decided that checks were needed throughout the whole materials program in order to hold back the rising tide. Accordingly, the inventory control department was requested, in taking physical inventories, to report any instances of excessive inventories, and of obsolete material on hand. Now the materials conservation department is able to see that each plant uses up excessive stocks. Anything that cannot be used is cataloged and offered for sale to other war production plants.

To stop unnecessary purchasing, and insure the use of excessive stocks, all purchase requisitions pass through the section of materials order control before being sent to the purchasing department.

The material conservation department is organized in six sections:

1. *CMP Coordinator* — Checks against excessive ordering and prepares ASU-41 and other government reports.

2. *Inventory Control*—Responsible for taking physical inventories in order to reconcile book records, and reveal high inventories and obsolete materials.

3. *Materials Order Control*—Screens requisitions in order to transfer the excess material of one plant to another.

4. *Surplus Sales*—In charge of selling surplus and obsolete materials to other companies.

5. *Outside Warehouse* — Insures proper segregation of inactive stocks that have been removed from the vicinity of the operating plants, thereby eliminating confusion of materials.

6. *Material Salvage and Waste Control*—Responsible for keeping factory waste to a minimum, collecting all scrap, saving everything salvageable, and returning it to production.

The first three of these six groups have been set up in order to keep back the tide of rising inventories. There are controls and checks so that the volume of raw stock will not continue to increase unnecessarily. The fourth group, surplus sales, is the means of disposing of whatever material becomes of no use to the company, the fifth physically stores and handles this class of material in an outside warehouse. The sixth, material salvage and waste control, provides for the best possible use of the byproducts from production. All six, taken together and properly operated, constitute a successful administration against the evils of waste.

Committees, such as the clean-up and improvement committee and the good housekeeping committee, meet regularly. Tours of inspection of the plant are a feature of the meetings, and the suggestions for improvements they turn in cover a wide range.

After the war, the benefits of conservation will still be reaped. Costs of production will be lower, and working conditions will be bettered because of the lessons that have been learned.

Good Food the Keystone of Employee Morale

RUTH SCHARREN, Director of Personnel, Argus, Inc., Ann Arbor, Mich.

EMPLOYEE MORALE is influenced by a wide variety of factors, but the management of Argus, Inc., Ann Arbor, Mich., believes good food is the keystone. The opinion is based upon this company's experience with its plant cafeteria for the past two years.

Argus management has not been hesitant in using other morale-building devices. These include incentive, profit-sharing, and retirement programs, also extensive development of mechanical aids, and much attention to employee safety. But if an employee who has all these advantages does not get good food and enough of it, he will look at the world and his company through "dark-colored glasses." At least, that's the official view in this company.

Substantial foods in comfortable surroundings are called a major factor in maintaining good morale among employees at Argus, Inc.

More Space Allowed

In the belief that the old adage, "an army marches on its belly," is just as applicable to home-front workers, too, it was decided in March, 1943, to make major improvements in the plant's cafeteria. The first step was to increase the cafeteria size, approximately quadrupling it. This was done by converting 3000 square feet of area that previously had been used for factory purposes. When finished, the cafeteria occupied a well-lighted, air-conditioned space 80x40 feet, with an 18x54-ft. space for cooking and serving facilities. It was then turned over to a concessionaire with long experience in the restaurant business for actual operation.

With these improvements, and the better food and service, employee response was immediate. In the first six months, food sales increased 133 percent, although the number of employees on the payroll had gone up only 8 percent. More significant, absenteeism showed a considerable decline, and has continued to run lower than the average of other plants in this district.

Management at Argus credits this improvement not only to a better attitude but also to better health. With better food there was less sickness, and a consequent lowering of the number of stay-at-homes.

Also there was better production inside the plant. With better food there was less fatigue. In addition, there was the contributing factor of attitude which was itself partly a product of better health.

Rearranged, the cafeteria was equipped to serve 1000 persons three times a day. Twelve enameled tables were provided with a combined bench seating capacity of about 200. Lunch hours are staggered so that the 200 is adequate, and the average occupancy at any one time is usually not more than 170.

Cooking and serving facilities include one 6x8-ft. walk-in refrigerator, a reach-in refrigerator, a six-burner elevated grill with double oven restaurant range, two 6-ft. steam tables, a 6-ft. salad pan, a 4-ft. beverage rack, a bob-tail soda fountain, an automatic dishwasher, an ice cream cabinet, a milk cooling cabinet, and worktables.

Feeding the Argus "family" is a full-time job for eight people—manager, cashier, cook, two assistant cooks, salad girl, and two dishwashers and general cleaners.

Here is a typical menu: Home made chili, tomato noodle soup, hamburger and French fried potatoes, boiled beef and spinach with potato, roast pork with dressing and potato, wax beans, peas, pear and cottage cheese salad, assorted frozen salads, lettuce and tomato salad, home-made pie, coffee, tea, milk, orange drink, assorted sundaes, and ice cream. Food prices have been raised on but one item. Pie is now 12 cents instead of 10. The increase has not affected its sale.

Controlling the Production of Subcontractors

PAUL R. FIELDS, Assistant General Manager, F. L. Jacobs Company, Detroit

INCLUSION of all its subcontractors in a single set of production controls, operated by the F. L. Jacobs Company, Detroit, has resulted in improved coordination of the efforts of all, and in a number of other benefits.

In late 1941 contracts for a large item used in tank assembly were received by this company, and production was under way by the middle of 1942. Originally the intent was to fabricate approximately 50 percent of the work in this plant, but subsequent increases in the contract quantities made it necessary to sublet about 80 percent of the business. The total monthly tonnage involved would require some 1200 carloads of incoming and outgoing freight—too large a job for handling in the space and with the manpower available.

Working Out the Systems

The obvious answer was subcontracting, and, in the administration of the large number of subcontractors necessary, precise purchase and production control systems had to be worked out in order to prevent tie-ups of the assembly operations. But before launching into the character of these controls, two policies which greatly simplified operating methods need to be mentioned.

Experience in the first few months of operation indicated that many of the subcontractors were not experienced in the intricacies of the Controlled Materials Plan. Moreover, since many of them were small, their materials requirements, steel let us say, were not sufficient to constitute a mill run. The policy was then decided upon to buy all materials for all subcontractors. This meant that Jacobs Company would buy billets from the steel mills, ship to forging or fabrication subcontractors for conversion into shapes, buy the forgings for machining subcontractors, and buy the finished part from them. This relieved subcontractors of CMP detail and permitted scheduling in volume production to all steel mills, foundries, forging, and other subcontractors.

Materials then could be allocated to subcontractors with assurance that the whole system was balanced with Jacobs Company's commitments for delivery of the complete assemblies. Allocations then constituted a pool

Each stage of production has an individual record sheet to show data concerning requisitions, purchase orders, and quantities the subcontractors have been authorized to release to other companies for subsequent processing. For example, there is one sheet with such records for casting a certain bracket, and another similar set for machining the same item

MATERIAL RECORD		CARD 1 OF
Specification 4C2 Casting		VENDORS
Alternate -	No.	Name
Alternate -	1	White Machining Co.
Purchase Unit -	2	Blue Mfg. Co. Inc.
How Purchased Machining	3	Red Tool & Mach. Co.
Size - Finish -		

MATERIAL RECORD				CARD 1 OF	
Specification 4C2 Casting				VENDORS	
Alternate -				No.	Name
Alternate -				1	Davenport Casting Co.
Purchase Unit -					
How Purchased Casting				2	Chicago Forging & Casting
Size - Finish -					
Unit Size - Weight - 368#				3	Steel Casting Inc.
Supersedes - D-37893					
Superseded by -					
	Min.	Norm.	Max.		
Quantity	15	20	25		
Days					

REQUISITIONS				PURCHASE		
Date	Number	Quantity	Accum.	No.	Date	Order No.
3-8	904	22800	22800	1	3-11	L-2196
6-14	1096	57200	800000	2	3-11	L-2199
1-21	C-462	15000	65000	3	3-13	L-2214

from which subtractions were made as materials were released to subcontractors. Advance covering for materials could be made on a basis of exact knowledge as to the current picture; and, of course, cancellations became much less troublesome. Follow-up detail was markedly reduced, and there was always available full information concerning the status of materials throughout the system.

In setting up the subcontractors, help was furnished in some cases in the form of production engineering service, and by supplying, at times, fixtures and gages. Generally they were tooled for continuous volume production with provision for 25 percent excess over scheduled requirements. Financial rating and background of the vendors were examined before business was placed with them.

Concurrent with this policy of purchase of materials for subcontractors was the procedure regarding engineering changes—of which there have been a great many. With so many subcontractors, changes in early 1942 involved a tremendous amount of detail and individual contact and consultation. This experience led to a policy which greatly simplified engineering change procedure. Representatives of all subcontractors affected by a change were called in—forging, foundry, and machining vendors—and met with representatives of Jacobs engineering department. Flaws in design were discussed, and improvements suggested to help machining vendors.

Under One Head

Another confusion-eliminating policy also may be identified before detailed consideration of control procedures is taken up. All plant functions dealing with materials control and handling are grouped under one head, the assistant manager. Thus, with the record plan to be described, one man has a complete grasp at all times of the exact status of materials in the plants of all the contractually related concerns. The functions are: (1) Purchase; (2) planning, materials follow-up, and production control; (3) traffic; (4) plant materials supervision; (5) stores, receiving, and shipping; (6) production and methods engineers.

With one exception, operations in the Jacobs plant were of an assembly nature. These were laid out on a straight-line flow basis. In this case, production control in the plant could be on a quota basis—so much output from each operation according to the level set by requirements for delivery of the finished products. This made it important for subcontractor control to mesh with the assembly schedule. How this was done may be illustrated by using a bracket as an example, because this item first is cast by a foun-

PART NAME Bracket Machining PART NO. D-47526

VENDORS					SAMPLE	
Address	Shipping Point	Routing	Frt.	Capacity	Approved	Rejected
Apayd, Ohio	Same	Howe Trk.	P.P.	1000 Week	7-3-42	
Dubuque, Iowa	Same	Autotate Tr.	P.P.	1000 Week	7-10-42	
Detroit, Mich.	Same	Their Trk.	P.P.	1100 Week	7-30-42	7/18 - 7/25

PART NAME Bracket - Casting PART NO. D-47526

VENDORS					SAMPLE	
Address	Shipping Point	Routing	Frt.	Capacity	Approved	Rejected
Davenport, Iowa	Same		All	500 week 6 days	6-9	5-27
1502 Hale St.	Same		"	800 " 6 "	6-2	
Chicago, Ill.						
1219 Sq. St.	Same		"	1800 " 6 "	7-8	6-19
Cleveland, Ohio						

ORDERS			RELEASES							
Quantity	Total	Accum.	Auth.	Date	Vend.	Release No.	Quantity	Total	Raw Mat.	Accum. Release
3600	3600	3600	1	3-12	1	2206	1200	1200	White Mach. Co.	
5900	5900	9500	1	"	1	2207	1200	2400	Blue "	"
13300	13300	22800	1	"	1	2208	1200	3600	Red "	" 3600

dry, then is shipped to a machining company before it comes back to Jacobs for assembly.

The start of materials control is in the schedule given to Jacobs by the sources of its original contracts. These are entered on one master schedule sheet—names of the buyers horizontally at the top, and the months covered by the contracts vertically; additions horizontally by months give the total commitments. This is the capstone of the material control structure; from its flows purchase and production control. It is made out whenever the figures change enough to warrant reissue. With this schedule goes the spare parts schedule—a fixed ratio of spare parts to assembled units is called for in the contracts.

Based upon this schedule, the purchase control was set up. Since Jacobs Company bought raw materials for the initial subcontractors, it had also to sell them to succeeding fabricating subcontractors at a price agreed upon at the time contracts were placed. Releases to the group of subcontractors were governed by Jacobs Company's own production control department. This procedure is illustrated by part D47526—the bracket—product of an initiating foundry subcontractor, machined by a different subcontractor, and shipped by the latter to Jacobs for assembly.

Shows When to Order

A survey of the master schedule indicated, in conjunction with the specifications, the quantities required ahead during the months of the existing contracts. Then the decision had to be made how far ahead commitments in the form of purchase orders to subcontractors were to be made. In general, covering orders for nine months were used at the start of the program, and orders were issued quarterly thereafter. This worked quite well as illustrated by heavy cancellations which occurred about the middle of last year. There was a large cushion of orders on the books for which materials had not been ordered; with exception of a few hard-to-get items, these cancellations did not bother seriously. The succeeding quarterly buy was not made, which kept the commitments in order.

When the period ahead for commitments was decided, production control issued a requisition to the purchase department to buy a specific number of castings of the part used herein as an example. The material record sheet for Bracket Casting, illustrated on pages 126 and 127, shows that three companies supplied this particular casting. Also, requisitions, purchase orders, and releases are noted, together with specifications and engineering change data. To be noted also are the capacity figures entered for each foundry subcontractor—a guide in placing purchase orders. All figures are stated cumulatively. A quick check thus is possible as to whether orders cover the requisitions; and whether releases by production control have absorbed existing purchase orders. In the release portion of this record it is to be noted that the releases from each foundry are directed as shipments

Davenport Casting Co. CARD 1 OF PART NAME Casting Bracket PART NO. D-47526

Purchase Orders				Purchase Orders				Purchase Orders			
Date	Order No.	Quan.	Total	Date	Order No.	Quan.	Total	Date	Order No.	Quan.	Total
3-11	L-2196	3600	3600								
6-15	L-2906	9200	12800								

Receipts				Receipts				Receipts				Net Total Shipped
Date	R. R. or R. M. O. No.	Quan.	Total	Date	R. R. or R. M. O. No.	Quan.	Total	Date	R. R. or R. M. O. No.	Quan.	Total	
To White Machining Co				To Blue Mfg. Co. Inc.				To Red Tool & Machine				
	MAY	1944			MAY	1944			MAY	1944		
21	F 802	4	4	25	F 601	6	6	22	F 703	3	3	13
	JUNE	1944			JUNE	1944			JUNE	1944		
1	F 807	17	21	2	F 603	28	34	6	F-707	14	17	
8	F 814	29	50	9	F 607	21	55	9	RMO 4512	12	5	
12	F 819	35	85	14	F 613	17	72	17	F 713	31	36	
25	F 821	36	121	19	F 616	28	100	26	F 716	56	92	
	JULY	1944		27	F 621	34	134	28	F 719	5	97	352
2	F 826	59	180		JULY	1944			JULY	1944		
10	F 831	60	240	13	628	75	209	3	F-721	71	168	
27	F 837	60	300					8	F-724	62	230	
								19	F-729	83	313	
								25	F-731	101	414	923

A separate part record sheet for each subcontractor keeps production control executives posted on the quantities shipped by the subcontractor to companies that are to work on the part next

to particular machining vendors—White Machining, Blue Manufacturing, Red Tool & Machine.

The next step in the purchase control is shown in the Bracket Machining record sheet, also shown on pages 126 and 127. This record, in purpose, is an exact parallel to the Bracket Casting sheet. On the machining record, however, are listed the machining subcontractors to whom castings have been sent by the foundries at the direction of the production control department. This machining vendor card must balance with the foundry card as to quantities ordered, and, of course, may be compared with the master schedule to show the extent of coverage in relation to the master schedule of contracts for complete assemblies.

Tells When to Ship

A vendor shipping release is issued to control movement between subcontractors and the assembly plant. In the case illustrated, it would direct one of the foundries to ship a definite number of castings to a machining vendor on specified dates. At the bottom of the second or planning department copy of this release is space for entry of shipments made by the castings vendor to the machining vendor on authority of this release. Entries in this space (and also additional space on reverse side) are made from "notice of shipment" reports. A cross check on this is the "foreign receiving report," sent to the production control department by the foundry vendor when shipment is made.

Before proceeding further with subcontractor relations, the production control schedule should be mentioned. This is made out monthly as a statement of what is to be produced in the assembly plant, and is based, of course, upon the master schedules of the buyers of the finished assemblies, but also absorbed in it are allowances for scrap, reworks, and inventory gains or losses. This schedule determines the grand total required as of any given date. In turn, it is the base for controlling the requisitions on the purchasing department and the releases to the subcontractors. From it is determined whether further purchases or cancellations should be made.

These purchase controls establish the materials position at the Jacobs plant—that is, the commitments in relation to projected requirements for finished product deliveries. Releases to casting vendors were made with a knowledge of the process time of machine vendors, shipping time, and needed banks—generally ten days' requirements of castings before first operation of machining. In turn, releases are issued to machining vendors in quantities to meet the assembly plant's schedule.

Production control for subcontractors helps keep the Jacobs Company's assembly lines running without interruption. About 80 percent of the parts it assembles are produced by subcontractors

The form on the facing page shows the complete information as to production status of one of the foundry subcontractors—the purchase orders issued, and the shipments made to each of three machining subcontractors.

Since there are three casting vendors, production control required a complete picture of material status at these plants. This is given by the master casting card. On this record are summarized the data from the individual cards for each company.

Another control form is used to record the purchase orders issued to each machining vendor, and the receipts from them to the assembly plant. Entries here are made from regular receiving reports. This information, when entered on the master casting card, affords the composite picture of the status of the bracket—the number shipped by each foundry to each machine vendor, the number shipped by the latter to Jacobs, and the balance on hand at each machine vendor at the end of each month.

A record of shipments of finished products on the main contract also is required. As daily shipments are made, they are entered on a "daily and accumulative record of shipments," which may be constantly evaluated against the master monthly schedule.

This analysis has been made for the purpose of showing that production control methods may be devised to coordinate the many subcontractors involved in producing an item in which some 80 percent of the work is done by them. Although these controls were designed to meet a typical problem of wartime production, they are not without application to reconversion to peacetime operation. It is likely that war items will, for a time, be run concurrently with consumer production—plants will be in all stages of readiness to take on new business. And a production control plan, such as this, may be depended upon to pull geographically dispersed procedures into a coordinated whole.

Bonus Plan Improves Machine Efficiency

J. S. PETRO, Standards Engineer, Thompson Products, Inc., Cleveland

A GROUP PIECEWORK INCENTIVE PLAN with a guaranteed day rate is in effect in all Cleveland plants of Thompson Products, Inc. One of the groups consists of 80 fully automatic machines. This group constantly showed an efficiency much less than the average of all other groups in the plant. An incentive plan, pointed specifically to keeping machines operating, was installed and has shown considerable increase in production units and bonus earnings without increasing costs.

Standard practice in most wage incentive plans is to establish a normal cycle time value for performing an operation. To this cycle time are added normal delay and personal allowances. A standard quota is then established.

This plan encourages the workman to exceed his production quota, thereby increasing his earnings during the time that the machine is in operation, or idle due to normal delays. In cases of abnormal delays, daywork hours are granted to the operator for the length of the delay.

In the past, very little thought has been given to the angle of providing an incentive plan to encourage the workmen to keep the machines operating as close to 100 percent of the time as possible. This type of machine efficiency incentive can show exceptional results, especially on fully automatic machine operations and also on semi-automatic machine operations where the machine time controls at least 50 percent of the total operation cycle time.

Previous to the installation of the incentive plan, a check showed that machines were in operation approximately 65 percent of the standard expected machine operating hours. In addition to this low machine efficiency, employees were discontented with the small amount of bonus they were earning. In carefully analyzing this group of machines, it was found that, regardless of the amount of effort the operator put into increasing machine efficiency, it would not increase the amount of bonus he received, since the production of the machine was controlled by the established automatic cycle time, and abnormal idle machine hours were paid for at guaranteed hourly rate plus the average bonus of the last three pays, regardless of the number of abnormal idle machine hours (Table I).

No Additional Bonus

Now assume that the operators of the machines put in exceptional effort and used all their skill to get the machines back in operation when a delay occurred, and, by this application, reduced the abnormal idle machine hours 50 percent, or to 1900 hours, thereby increasing the productive hours of the machines by 1900, the results of the bonus earnings of the group would be as shown in Table II.

In checking over the two tables, it should be noted that in Table 2, a total of 8505 standard hours of work was produced compared to 6510 hours in Table I. In other words, in Table 2 the group produced 1995 more standard hours of work than in Table 1, but the bonus earnings in both are the same.

Employees soon realized that regardless of their efforts they could not increase their bonus earnings by eliminating abnormal idle machine hours.

Standard production requirements for these automatic machines are established by actual time study of the cycle of the machine, and compared to the engineering layout sheet. To the established cycle time are added all normal tool, miscellaneous, and personal allowances, arriving at a standard time value per piece. With this practice of establishing standards, the expected production of these machines was 77.5 percent of capacity. Because the machines were set up according to the engineering layout, no opportunity was left for the operators to reduce the cycle time per piece.

The result was that the only incentive remaining for the operator was to reduce the normal tool trouble time, also to take less personal time, than allowances were made for. The maximum amount of incentive on these

Table I

Standard hours of work produced	6510
Abnormal idle machine hours	3800
Allowance on abnormal idle machine hours at average bonus of last 3 pays (average bonus 5 percent)	190
Total group allowed hours	10500
Total group actual hours	10000

Group Efficiency

$$\frac{\text{Total group allowed hours}}{\text{Total group actual hours}} = \frac{10{,}500}{10{,}000} = 105\%$$

Bonus = group efficiency minus 100%

Bonus = 105% − 100% = 5%

Table II

Standard hours of work produced	8505
Abnormal idle machine hours	1900
Allowance on abnormal idle machine hours at average bonus of last 3 pays (average bonus 5 percent)	95
Total group allowed hours	10500
Total group actual hours	10000

Group Efficiency

$$\frac{\text{Total group allowed}}{\text{Total group actual hours}} = \frac{10{,}500}{10{,}000} = 105\%$$

Bonus = group efficiency minus 100%

Bonus = 105% − 100% = 5%

machines was 29 percent, providing the operator was able to keep the machine running 100 percent of the working day. To accomplish this, he had to stay at his machine the entire day, taking no personal time and requiring no tool adjustments or changes.

It is a practical impossibility to operate a fully automatic machine 100 percent of the time. This was demonstrated by the fact that the group was only earning a small percent of bonus. The low machine efficiency was the result of the lack of incentive to get the machines back into operation whenever abnormal delays occurred. The operators of the machines received daywork credit for these abnormal delays and would not endeavor to correct them and get the machines operating in the least amount of time, because of the daywork allowances and also because it would not increase their bonus earnings.

Group Allowance

With the incentive system on a group basis, and over a cumulative two-week period, it was felt that an over-all percentage allowance could be established for all delays in this group. The purpose of this percentage allowance was to encourage the operators to keep the machines in operation as many hours as possible, thereby increasing their bonus earnings and still maintaining the same labor cost.

A study of the delay hours of these machines was made, covering a period of three months, or approximately 169,000 machine hours, excluding set-up hours. The study revealed that the original normal tool allowance for changing and adjusting tools was sufficient, but miscellaneous allowances did not cover all items that were classed in abnormal delays.

These allowances covered such items as excessive tool trouble, wait for tools, minor machine trouble and repairs, clean machine, spindle trouble, change oil line and rollers, repair run-outs, inspection holdup, and many other minor items too numerous to mention. A careful analysis of these delays was made, corrections were recommended, and made where service departments were the cause of idle machines. Delays were analyzed to discover also whether they were caused through the negligence of the operator or whether they were due to machine or tool failure. Where operators' negligence could be proved, delay times were eliminated. Also the amount of time required to get the machine back in operation was analyzed to see whether the time was excessive, normal, or exceptionally good.

The actual time study of these machines revealed the following:

Actual machine hours observed	168,871
Standard machine hours of work produced	110,329
Abnormal idle machine hours	61,919

The 61,919 abnormal idle machine hours consisted of such items as mentioned above, which were not included in the time study by which the standards were established, and also the hours that exceeded the standard delays allowed in the time study.

Analysis of the abnormal idle machine hours of 61,919 showed that 11,168 hours were the fault of the operators and service departments, and 50,751 hours were caused by machine and tool failure.

When analysis had been completed and idle machine time established, it was necessary to convert idle machine time to a percentage of the expected operating machine time.

The analysis now showed that 110,329 standard machine hours of work were produced and that, in order to produce these hours of work, it took an additional 50,751 hours of abnormal delay such as tool adjustment, tool grinding, machine adjustment, repairs, and so forth.

In order to set up the 50,751 hours on an incentive basis, it must then be assumed that for every 110,329 standard hours of work produced, 50,751 additional hours must be allowed. In order to make this allowance, it is necessary to determine what percent the additional allowed hours are of the standard hours of work produced. This was done as follows:

$50{,}751 \div 110{,}329 = 0.46$ or 46%

The application of the 46 percent is made by adding to the standard hours of work produced during the day, the 46 percent allowance.

For example, if the group produced 100 standard hours of work, the allowed hours for the day would be $100 + 46$, or 146 hours.

A meeting with the employees of the automatic group was called and a detailed explanation of the delay study and the percentage delay allowance was presented to them. During the meeting, it was made clear to the employees that the purpose of this percentage delay allowance was to enable them to earn additional bonus by eliminating the idle machine hours in the group. It was also pointed out to

Table III

Actual hours time studied	168,871
Actual allowed hours 110,329 + (61,919 × 1.05)	175,344

Efficiency calculation $\frac{175{,}344c}{168{,}871} = 104\%$

Bonus = 104% − 100% = 4%

Table IV

Standard hours produced during study	110,329
Standard hours produced by eliminating hours due to their fault (11,168 + 2%)	11,391
Standard hours produced by reducing abnormal delays (50,751 × 0.50) 1.02	25,882
Total standard hours produced	147,602
Allowed delay hours (147,602 × 0.46)	67,897
Total group allowed hours	215,499

Group Efficiency

$\frac{\text{Total group allowed hours}}{\text{Total group actual hours}} = \frac{215{,}499}{168{,}871} = 127.6$ or 128%

Machine Efficiency During Time Study

$\frac{110{,}329}{168{,}871} = 65\%$ machine operating of the standard expected machine operating hours

Theoretical Machine Efficiency

$\frac{147{,}602}{168{,}871} = 87.4\%$ machine operating of the standard expected machine operating hours

them that with the application of the percentage delay allowance, the day-work allowance would be eliminated, regardless of the length of delay.

The examples presented to the group were a recapitulation of the bonus earnings during the time study (Table III) and also a bonus calculation for the same period (Table IV) with the application of the proposed percent allowance, assuming that they applied better effort and skill than they had during the time study.

Referring to Table III, suppose that through the efforts and skill applied by the group, they eliminated the 11,-168 hours of idle time that were their fault, and also reduced the allowed delay hours by 50 percent, and converted these hours into production, the result would be as shown in Table IV.

After these explanations had been made, it was proposed to the group that they accept the percentage delay allowance. After a number of questions had been answered, the proposal was finally accepted by the employees under the condition that for a period of four weeks they would put every effort into keeping the machines in operation, and if the results of their honest efforts did not show a reasonable increase in their bonus earnings, the original method of compensating for abnormal delays at day-work rates would be resumed.

A second meeting of the employees of this group was not necessary. Since the installation of this plan, a gradual increase both in machine efficiency and in bonus earnings has been in progress.

The latest pay period of 14 days shows the following:

Actual hours worked.....10,249.8
Total standard allowed hours.14,480.0
Bonus efficiency 141%

The total standard allowed hours represents the standard hours of work produced plus 46 percent. In order to determine the standard hours of work produced, the 14,480 standard allowed hours are divided by 1.46—resulting in a total of 9918 standard hours of work produced (9918 ÷ 10250 = 96.8% machine operating of the standard expected machine operating hours).

The incentive compensation to the employees of a group is calculated on a percentage basis and referred to as bonus. The incentive bonus calculation is made by totaling daily the production of the employees in a group and accumulating the daily production for a two-week period. The group-accumulated two-week production is then converted into dollar value and compared to the guaranteed group dollars for the actual hours worked in the group during the two-week period. The comparison of the actual guaranteed group dollars to the dollar value of production is known as the group efficiency. The bonus percent the group is paid is the difference that the group efficiency is in excess of 100 percent efficiency. Each employee receives the same percentage of bonus on all hours worked in the group.

Principles of Wage Law Enforcement

ENFORCEMENT of the law against the making of unauthorized wage adjustments is a part of the emergency war program to prevent wage and price inflation. To help employers understand the policies and procedures involved in such enforcement, the National War Labor Board has issued the following statement of principles:

1. The primary objectives of the enforcement program are the elimination of unlawful and unstabilizing wage practices, and the protection of employers and employees who do comply with the rules against the unfair competition for labor of those who have failed to comply.

2. Like all other phases of the board's work, authority to determine whether a violation exists and, in appropriate cases, to reduce or eliminate the penalties provided by law, is exercised by tripartite divisions of the regional boards consisting of an equal number of representatives of employers, employees, and the public. The tripartite character of each such division enables it to appraise fairly and understandingly the variety of circumstances under which violations occur, and to give just consideration in each case to the existence of extenuating circumstances.

3. No penalties may be assessed against an employer without his consent except after a hearing and decision by a tripartite division. There is a right of appeal from any such decision to the National War Labor Board.

4. The board's experience has shown, however, that the great majority of cases can be settled with the employer's consent through a simple and informal procedure which does not involve expensive or protracted hearings. Each such voluntary settlement is presented to and acted upon by the tripartite division.

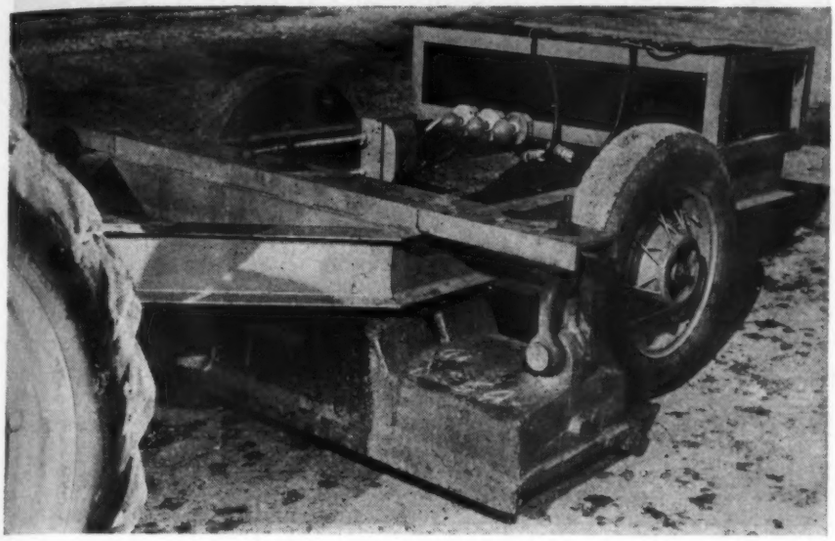
5. In the normal case it is not necessary for employers to engage special or technical consultants, although they may, of course, be represented in any proceeding by anyone they choose. Complaints have been made to the board, however, that certain individuals have exaggerated the potential penalties that are likely to be incurred, and have claimed special ability to achieve lenient disposition of cases. Any such claims are wholly unwarranted.

6. In any case where it is found that improper payments have been made under extenuating circumstances, the prescribed penalties may be reduced or eliminated. The severity of the full sanctions provided by law is reserved for the cases which involve intentional and willful violators as, for example, the second offender, or one who has put an adjustment in effect after disapproval by the board, or one who has failed to discontinue an unauthorized adjustment.

7. There is no mechanical formula by which the amount of penalty can be determined in advance in any case. Each case must be decided on its own particular facts. The employer's voluntary disclosure of the facts and prompt cooperation in discontinuing unauthorized and unstabilized rates or practices are regarded as important indications of extenuating circumstances. The immediate discontinuance of unlawful and unstabilizing rates or practices is an absolute condition in any case where the board is asked to reduce or withhold the penalties.

MANAGEMENT SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for



About 1000 pounds of scrap in its first 8 hours of operation is the record of the magnetic device designed and built by the plant engineering department of Consolidated Vultee Aircraft Corporation, Nashville, Tenn. Before this machine was put into operation in the roadways about the plant, tire repair bills ran as high as $150 a month. They have now been reduced by 75 percent. Machine is of angle iron construction, on Ford wheels; it carries two 1000-lb. magnets operated by four 12-volt storage batteries

Electric eye prevents fingers being jammed in spot welding machine

Foremen Play Big Part in Recreation Club

Recruiting for members in the recreation association, recently organized by employees of Wollensak Optical Company, Rochester, N. Y., was placed squarely up to the foremen by the workers. The foremen vied with one another in a membership drive which resulted in the enrollment of 90 percent of all personnel.

Employees and foremen associate with one another in promoting all activities. They built regulation horseshoe courts on company property, conducted excursions to local and out-of-town football and baseball games, held tennis and golf tournaments, and put well-coached baseball and basketball teams into Rochester industrial and independent leagues.

Any member of the recreation association can become an officer, and when time came for electing a nine-man board, five of the nine men chosen by the entire membership turned out to be foremen.

Managment of this company is enthusiastic about the physical fitness and improved morale generated by the recreation association. Every initiation fee dollar was matched by the contribution of a company dollar for the recreation association treasury. Teams were outfitted, trophies were put up for competition, and a darkroom is being installed.

Organized "to encourage, finance, and carry on recreational activities to be participated in by employees of both sexes and all ages, and to promote mutual acquaintance and cooperative spirit among its members," the association has produced an important byproduct—a social mixing of labor and management.

•

Electric Eye Makes Spot Welding Safe

A. G. SCHAEFER, Production Manager, Spencer Thermostat Company, Attleboro, Mass.

In the past dozen years the use of air-operated spot and projection welders has increased tremendously. Most of these machines are used for welding small assemblies or subassemblies, and they usually operate at high speeds. Usually, too, elaborate fixtures are used to position the work, which means that unskilled operators, mostly women, can be used. But one little slip, and fingers are jammed, sometimes seriously hurt.

To offset this danger we are using an

electric eye as a safety device on spot welding equipment. The spot welder is foot controlled; it is pneumatic or air-powered; it has 80 pounds of pressure on the upward swing of the welding electrodes and 40 pounds on the downward swing. The operation of the safety device is such that any object coming into the light beam of the electric eye immediately shuts off the air pressure on the downward swing and activates the pressure on the upward swing. This is a surprisingly fast action, and it is impossible to get fingers caught.

•

Price of admission to a dance held recently by employees of Libbey-Owens-Illinois Glass Company, Toledo, was a letter written to a service man or woman.

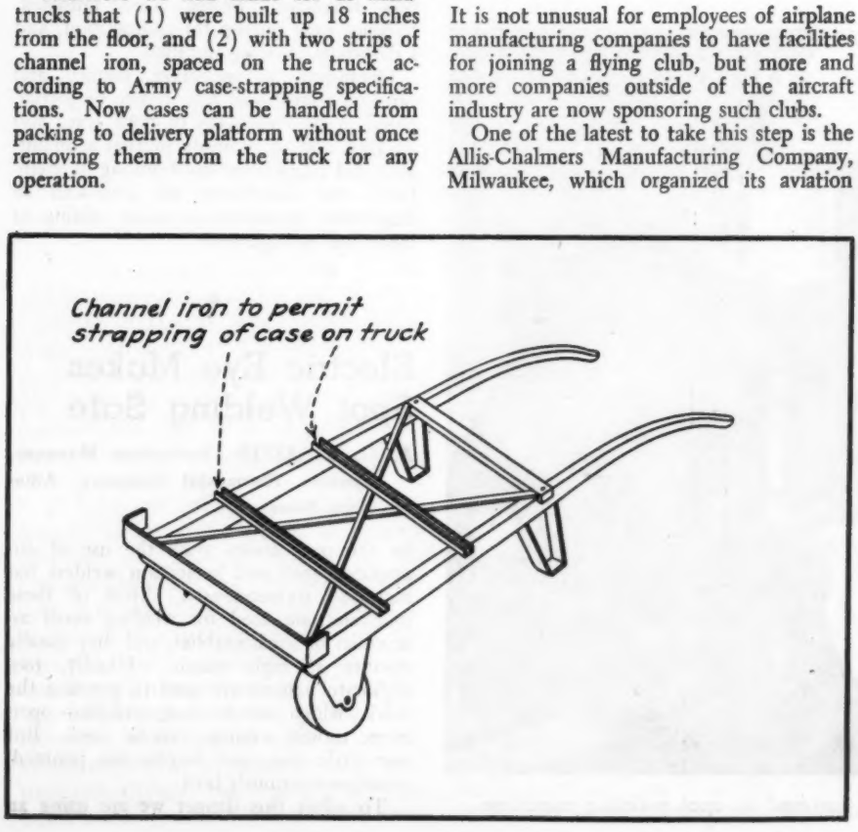
•

Strapping Simplified on Special Truck

WILLIAM McCLOSKEY, Industrial Engineer, Masback Hardware Company, New York

We had the problem of handling some thousands of cases for the Army Quartermaster. These cases had to be packed, marked with identification colors, stenciled, and strapped. The strapping operation was a bottleneck, because we had to take the case from the handtruck, prop a block under it, strap it, and put it back on the truck.

Therefore we had made for us handtrucks that (1) were built up 18 inches from the floor, and (2) with two strips of channel iron, spaced on the truck according to Army case-strapping specifications. Now cases can be handled from packing to delivery platform without once removing them from the truck for any operation.



Stock selector at Toledo Scale Company, Toledo, wastes no time groping for parts. Good seeing conditions in every part of the rooms are insured by lighting units suspended from bus duct. Units slide to point of use

Flying Club Organized by Workers

It is not unusual for employees of airplane manufacturing companies to have facilities for joining a flying club, but more and more companies outside of the aircraft industry are now sponsoring such clubs.

One of the latest to take this step is the Allis-Chalmers Manufacturing Company, Milwaukee, which organized its aviation club for the purpose of serving "all of the employees of the Allis-Chalmers Manufacturing Company who are interested in aviation, to encourage further interest and increase knowledge of aviation among this group, to provide means for all members to obtain adequate ground and flying training at minimum expense, to organize and operate a separate squadron of the Civil Air Patrol, and to provide at moderate rates the use of aircraft for all of its members." Membership is open to employees and their immediate families.

Four types of membership are available: (1) Social membership, a prerequisite for the remaining types of membership, which entitles the members to participate in all club functions; (2) flight membership for all members who are participating in actual flying; (3) training status membership for all members who desire to join the Civil Air Patrol; and (4) training and flight membership for all members who wish to participate in training in the Civil Air Patrol and at the same time participate in flying.

The flight section has been organized as a non-profit corporation. Members are eligible to fly club-owned aircraft by purchasing a $50 share in the organization and by paying for the actual cost of operation of the equipment.

The club has purchased a 65-hp. Piper Cub, which is to be called the AC-AC, and has on order a wrecked Army trainer which is to be renovated. The Navy Air Force has presented the club with a Mark IV navigation trainer—a dummy airplane with all controls, which duplicates actual flight conditions.

MAINTENANCE SERVICES

The well-maintained plant is the high-production plant

SELECTION • INSTALLATION • INSPECTION • UPKEEP • ORGANIZATION

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MAINTENANCE as the Editors See It

How Many Maintenance Men Are Enough?

How MANY motor inspectors, electricians, millwrights, and other maintenance personnel should be enough for a given plant? Management and maintenance executives frequently ask that question. It has been particularly pressing during the past two or three years.

Management is more likely to think that the maintenance department is overstaffed, than otherwise. Maintenance shrieks that it ought to have more men.

There does not seem to be any generally satisfactory answer to this question. Any attempt to work out a fair answer must take proper account of many diverse factors. For example, the age and condition of equipment, the severity of exposure to adverse conditions, the amount of overloading, number of hours of operation a day—all these vitally affect the amount of maintenance attention needed.

Any kind of equipment that has behind it a long history of neglect and abuse certainly will require more attention than items that have been properly used and well cared for.

That same truth applies to buildings and everything else around the plant.

The philosophy behind the maintenance department also matters greatly. It is one thing to regard the function of maintenance as patching up after something breaks down. It is something else entirely to consider that maintenance should be vitally concerned with preventing troubles.

In any event, intelligent direction and competent supervision will go a long way toward getting real efficiency from maintenance personnel.

Then the question of how many largely resolves itself into a matter of deciding or determining how much manpower is needed to accomplish the results wanted.

Be Sure the Distribution System Has Ample Capacity

A SERIOUS MISTAKE may easily be made if the distribution system is not given careful consideration when planning post-war changes in the plant.

The distribution system in many plants is adequate for present needs and probably will carry heavier loads and serve satisfactorily for some time to come.

In many other plants the situation is less favorable. Although the system may serve to make energy available wherever it is needed, losses may be high, voltage drop excessive, reliability nothing to brag about, and the ability to carry much more load, non-existent.

It is necessary to recognize that plant distribution systems in general will be called upon in the future to carry heavier loads than ever before. For many years the trend has been toward greater mechanization, and larger consumption of electrical energy per worker.

Mechanization is certain to increase, rather than diminish. Larger machines, of greater output, will be used. Electrical power will be substituted in increasing measure for muscle power in handling materials. Lighting intensities will continue to go up. Arc welding will find more applications. Use of electronic heating, both induction and dielectric, may be expected to grow hugely.

All these trends mean that more, oftentimes larger, electrical apparatus will be hooked onto the distribution system.

It may be extremely difficult, if not impossible, to foretell the size of the electrical load five or ten years from now. But it will not be difficult to make sure that the plant has an adequate distribution system having ample reserve capacity.

Maintenance, Too, Can Use Standard Practice Sheets

THERE IS MUCH to be said in favor of the policy of issuing standard practice sheets for maintenance work. The idea is not new. In varying degrees, it has been put into effect in many plants. It seems worthy, nonetheless, of much wider application.

In one progressive plant, instruction sheets have been prepared covering the inspection, testing, adjustment, and to some extent the repair, of practically all equipment, as well as buildings. All points to be watched for trouble or deterioration are listed.

When a maintenance man is given an assignment, he is referred to the instruction sheet which covers that particular job. Hence it is considered that he has no excuse for overlooking some point, or failing to do good work. The instruction sheets have been worked up with such care, and revised so often, that few if any points have been omitted.

Contrary to what might be thought, this is not something that is worth doing only in large plants. The plant in question is relatively small, with a maintenance force of corresponding size. In such a plant the maintenance men often have to be able to handle a variety of work. The number of supervisors will obviously be limited. Hence the need for, and value of, written instructions. Their usefulness in training new men, too, will be apparent.

Standard practice sheets have long been an indispensable tool of production departments. If properly prepared, they can be of equal value to maintenance.

Rating Maintenance Jobs

EDWARD LENDER, Plant Engineer, Star Electric Motor Company, Bloomfield, N. J.

RATING of maintenance jobs and merit rating of maintenance employees at Star Electric Motor Company, Bloomfield, N. J., are accomplishing these three major objectives:

1. A fair wage rate is being paid for each type and grade of maintenance work.

2. This wage rate is being adjusted periodically between agreed minimum and maximum limits to reflect the workers' own efforts and abilities.

3. As a result, every worker knows that any change in the type of his job or the quality of his performance is being automatically recorded to insure his getting the right pay.

Star Motor's plan, which is being generally applied to both production and maintenance forces of this plant, is patterned closely after the well-known NEMA plan (National Electrical Manufacturers' Association), with minor modifications required by local conditions to obtain a more equitable adaptation. The possibility of successful application of such a plan to any maintenance department is frequently questioned because maintenance service type of labor, in contrast to production workers, presents an extra problem in applying the customary formulas used for evaluation of the worth of the job and the man. This problem can be summarized under two difficulties:

1. In rating each maintenance job, the development of a master sheet by analysis of the work involved does not have the advantage of dealing with repetitive operations as in most production jobs.

2. In merit rating a maintenance worker, the use of factual data usually provided by production records, such as daily output, and number of rejects, is not available for substantiation of the supervisor's opinion of that worker's performance.

That neither of these difficulties is seriously condemning or insuperable is attested by the present efficient operation of the job and merit rating plan in Star Motor's maintenance department since the plan was introduced into the entire plant more than two years ago. No better proof can be found of the plan's successful operation, not only in the maintenance department, but also in all production departments, than in its combined enthusiastic approval and acceptance by management, who initiated it, by the workmen, who have incorporated it into their union contract (Local No. 408, UERMWA, CIO affiliate), and by the supervisors, upon whom falls much of the burden of its administration.

In the maintenance department particularly, the successful application of the plan requires above all else a solid foundation of correct job classifications if the superstructure of merit rating is to stand. But how can sufficiently accurate job masters be developed from activities of such wide coverage as is involved in maintenance work? This question paraphrases the first-mentioned difficulty, that of defining work which is not of a repetitive nature and whose scope is at first glance seemingly as broad as it is long.

Actually, however, it will be found that each maintenance job does have fairly definable characteristics. But they will never become fully evident until one jumps in and makes a start in determining them. This chore is made easier, too, by use of the typical forms developed by NEMA and other organizations.

When maintenance job rating was begun at Star Electric Motor Company there were 13 job classifications drawn up for all activities of the maintenance department, in contrast with 25 job masters now in effect. This twofold increase in job masters took place despite a one-third decrease in maintenance personnel that occurred after completing the installation of new plant equipment. Furthermore, sometime in the plan's history all but one of the original 13 job masters have required revision, either upward or downward, and 12 new job masters have had to be added, because of better differentiation of what each man

Skilled maintenance electrician has no fear of being underpaid, or hope of being overpaid, because the job master, which lists the basic factors of his job, shows exactly the labor grade into which he falls

JOB RATING SUBSTANTIATING DATA

STAR ELECTRIC MOTOR COMPANY

OCC. CODE NO. 6A

DEPARTMENT Maintenance

JOB NAME Electrician-Maintenance CLASS 6A

FACTORS	DEGREE	BASIS OF RATING
EDUCATION	4-56	Requires the use of complicated wiring diagrams and specifications, wide variety of electrical instruments, or broad electrical knowledge. Usually equivalent to 4 years' high school and 4 years' formal training
EXPERIENCE	3-66	Over 1 year up to 3 years' working experience. Minimum experience at Star, 2 years
INITIATIVE AND INGENUITY	3-42	Requires the ability to plan and perform a sequence of operations where standard or recognized operation methods are available, and the making of general decisions as to quality, tolerances, operation, and set-up sequence
PHYSICAL DEMAND	4-40	Considerable physical effort, working with average or heavyweight material, or continuous strain of difficult work position
MENTAL OR VISUAL DEMAND	3-15	Continuous mental or visual attention requiring constant alertness
RESPONSIBILITY FOR EQUIPMENT OR PROCESS	4-20	Probable damage to equipment or process is seldom over $1000
RESPONSIBILITY FOR MATERIAL OR PRODUCTS	1-5	Probable loss due to damage or scrapping of materials or product is seldom over $10
RESPONSIBILITY FOR SAFETY OF OTHERS	5-25	Safety of others depends entirely on correct action of employee on job being rated, and carelessness may result in fatal accidents to others
RESPONSIBILITY FOR WORK OF OTHERS	2-10	Responsible for instructing and directing one or two helpers 50 percent or more of the time
WORKING CONDITIONS	2-20	Good working conditions. May be slightly dirty or involve occasional exposure to dust, dirt, heat, cold, or wet. Typical machine shop working conditions
UNAVOIDABLE HAZARDS	5-25 3-324	Exposure to accidents or occupational disease that may result in total disability or death

REMARKS Layout, install, and maintain complicated electrical generating, transmission, or control equipment. Must be able to work from wiring diagrams and schematic drawings. Expert trouble shooter, including electric testing apparatus. May involve high tension work. Works without direct supervision.

Job master for Class A electrician gives analysis of the eleven basic factors of the job as they exist at Star Motors plant, using the NEMA score system, shows that its No. 3 labor-grade wage applies

had to do. Some of the revisions were due to changes in the jobs themselves; others were the result of the progressive discernment of inequities.

The point being made is that perfection in setting up accurate job masters is never to be expected at the start, and that only by process of gradual evolution can such a plan reach the balanced stage. Moreover, at no time will the need for changes in job masters ever be eliminated, because sudden or subtle changes in plant conditions will occasionally occur that will require revaluation of rating factors to maintain the plan's integrity. A good job rating plan, therefore, must provide, as a normal rather than an abnormal part of its administration, for periodic review and correction of job masters. What appears therefore as a formidable problem in maintenance job rating because of the general lack of repetitive operations gradually eliminates itself as the plan matures.

The gradual and necessary refinement of maintenance job masters does not mean, however, that there need ever be any change in the basic factors for job evaluation. The basic job rating form at Star Motors has never been changed from the start. The illustration on page 138 depicts a typical maintenance job master for a Class A electrician, and shows the basis of rating the various factors of this job as they now exist at this plant. In the column headed "Degree" are shown both the degree and respective point values of each factor, using the NEMA score system. At the bottom is given the total point score and resultant labor grade.

Ten Labor Grades

A summary of all 25 maintenance job masters at Star Motors is exhibited below, showing their relative standings according to the ten labor grades adopted for all employees of this plant. This chart also identifies by circles the 13 original job masters, corroborating the elementary nature of the initial set-up, and revealing the nature of the more specialized job masters that were added later on. Wage standards for the ten labor grades in this chart are the result of a careful survey made of area and national industrial statistics, to insure their propriety, and constitute an essential part of the union contract.

The development of maintenance job masters at Star Motors, both original and revised, is not the result of one man's opinion. They are first worked up by the supervisor most familiar with the job requirements, together with an industrial engineer. Then, under the official sponsorship of a representative of the industrial relations department, they are guided through a routine of executive checks and counterchecks that concludes with a review by the job rating reviewing committee. This committee consists of the plant superintendent, personnel director, an industrial engineer, the industrial relations manager, and supervisor of time and motion study. Its character indicates the importance attached to production of correct job masters.

Any necessary revision of job masters is initiated by any one of three agencies—labor, supervision, or management. The union can successfully challenge the accuracy of a new or

General Job Classification and Wage Schedule

Maintenance Department, Star Electric Motor Company

Job Number	Labor Grade	1	2	3	4	5	6	7	8	9	10
	Maximum Wage	1.40	1.30	1.20	1.13	1.07	1.00	.93	.86	.79	.72
	Minimum Wage	1.25	1.15	1.05	.98	.92	.85	.78	.71	.65	.65
5. Millwright-Maintenance					B						
6. Electrician-Maintenance				Ⓐ		Ⓑ		Ⓒ			
7. Pipe Fitter			A	Ⓑ			Ⓒ				
11. Carpenter				Ⓐ	Ⓑ			Ⓒ			
11. Mason-Maintenance					B2						
20. Painter-Maintenance				Ⓐ		Ⓑ					
28. Furnace Tender						B1 B2					
32. Trades Helper								A1	B2		
35. Stock Selector							A		B		
37. Watchman									Ⓐ		
37. Coal Passer									A1		
37. Grounds-tender									A2		
37. Porter										Ⓑ	
37. Laborer											C
39. Matron-Maintenance											Ⓐ
40. Lubricator								A			
Points		360 381	338 359	316 337	294 315	272 293	250 271	228 249	206 227	184 205	162 183

Letters shown in circles indicate the original job masters for the entire maintenance department. The other letters represent job masters added later because of better differentiation of the work involved

The importance of correct job masters to the success of the job rating plan is recognized by the care with which all new or revised job masters are reviewed for final approval by the job rating reviewing committee, consisting of the plant superintendent as chairman, the personnel director, an industrial engineer, the industrial relations manager, and the supervisor of time and motion study

revised job master if it can support its claims of error. A workman who believes his job has progressed to a point where it requires more skill, effort, or responsibility than called for by his job master may file a formal grievance for revaluation of his job master. The time for filing, however, is limited to within a 14-day period after publication of the results of a regularly scheduled review of job and merit rating. This review takes place no sooner than every 4 months and at no longer intervals than 5 months.

Supervision and management may initiate a revision, however, at any time the need for an upward or downward revaluation becomes evident. It is conceivable, for instance, that the interim introduction of more complicated plant equipment may require an increase in point values for such factors as education, initiative, and ingenuity to justify a prompt revaluation of the necessary maintenance services to a higher labor grade. On the other hand, an improvement in tools, materials, or equipment could simplify the work to such an extent as to justify a reduction in labor grade. A split-up of duties and responsibilities of one job into two would produce the same result.

Usually, however, a change in a maintenance worker's wage rate is justified not so much by revision of the job master itself that governs his work, as it is by a need to apply another job master because his work assignments have been changed. A periodic review may reveal, for instance, that a maintenance man is doing enough of the work specified by the job master for the next higher class to deserve upgrading. The rule at Star Motors governing such reclassification is that a man must be regularly doing at least 75 percent of the work of the class in which he is to be reclassified. This rule wisely permits the maintenance supervisor a reasonable flexibility in making assignments to his men. It also eliminates the gross inefficiency occurring from shortsighted limitations that give rise to petty "jurisdictional" type of complaints whenever an iota of work of a higher class or different craft is involved. It benefits the workman, too, by making possible his training for upgrading.

Upgrading of workmen, while preferably done at the stipulated time of periodic review, sometimes cannot wait for such review, and requires interim action. For example, should a Class A electrician's job suddenly open up because of plant changes, the best qualified Class B workman would be in line for immediate promotion. After a trial period of 30 days he would then receive the minimum pay for the new job unless he was already earning more, in which event no change in pay would be involved until it became justified by the result of future periodic merit rating reviews.

Employees at Star Motors can be reclassified to a lower grade job for only four reasons:

1. Inefficiency.
2. Voluntary choice, where a worker desires opportunity to work into a better rated class.
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In the fourth instance, no reduction in the employee's pay follows until four months have elapsed, although his new job is rated in the

lower labor grade. If his old pay is over the maximum of the new job an effort is made, however, to transfer him to a job where he can earn his old rate.

Downgrading due to any of these four reasons is necessarily controlled by procedures conforming to good industrial relations, and involves consideration of various factors of seniority and merit not pertinent to this article. When a workman possesses no experience in the lower graded job to which he has been reclassified, he is paid the minimum for that class. Award of higher than minimum rate rests on proof of experience that enters into a formula used in determination of merit rating to be discussed later.

What are the practical aspects of these job rating procedures as applied to the maintenance department? Most of the practical values are derived from the continual emphasis of these procedures on job rating's primary objective of paying wages based on an unbiased appraisal of the worth of the job. Prior to job rating, the plant engineer was impotent to answer with much degree of success the complaint of a maintenance worker that he was underpaid in contrast with wages paid to production forces. Job rating has not only reduced the notorious "want-a-raise" parade to the plant engineer's office, but also has elevated all remaining complaints from the realm of personal opinions to a more definable and impersonal basis. Men now think more in terms of what they must do on the job to prove they deserve reclassification. Also, the plant engineer can make rebuttal on the same basis. If, for example, John Smith, a Class C carpenter, says he thinks he should be reclassified to Class B, it is now the accepted practice of the plant engineer to review both B and C job masters with him either to convince him he is wrong, or to prove the validity of his claim. Whatever the conclusion, both parties are satisfied that justice has been done, and if not, the matter is submitted to regular grievance procedure.

Another well-known bone of contention—the scale of wages for skilled and unskilled maintenance labor—has found means for easy settlement in job rating procedure. Much ill-will can occur when these wage rates are controlled by supply and demand or interplant rivalry. Under the job rating plan at Star Motors, all unskilled maintenance workers begin at the minimum wage of Class 32B2 as trade helpers, in which designation they remain until they acquire sufficient knowledge of the trade for reclassification to Class 32A or as a Class C craftsman. Every new unskilled man knows he is getting the same wage treatment, and that the opportunity for advancement depends on his own personal efforts to qualify for a higher rated position.

Trial Period at Low Rate

When it becomes necessary to hire a skilled maintenance employee from the outside, which is only done when no employee in the ranks is available for upgrading, he is started, for a 30-day trial period, at the lowest rate for the class in which he is hired. At the end of 30 days his classification is either confirmed for regular employee status and eligibility for merit rating, or he is reported as being of lower class qualifications. This can result either in demotion or discharge. This procedure exemplifies the predominant principle of job rating that assures a fair deal for all, and in this instance it removes any suspicion by old plant men that newer men are able to dictate better wage terms. Departmental morale is thereby sustained at high level.

Regulation afforded by job rating over changes in wage rates caused by occupational changes has simplified another problem common to the plant engineer. For example, during the prevalent labor shortage it is frequently necessary in an emergency to transfer a man to a lower rated position temporarily. Under the present job rating rules, such a man continues to receive his original higher rate. To insure the temporary nature of the position, however, no man can remain at the lower rated position for a term in excess of the second periodic departmental review. If that review reveals continuance of this situation, the transfer will be considered as a permanent reclassification, subject to lower rate, unless he is immediately reassigned to the higher rated work. In other words, temporary downgrading of a workman for the benefit of the company does not affect his pay, but a voluntary permanent downgrading requires actual wage adjustment.

These specific rules are equally helpful when a surplus of maintenance labor develops, as it can even in these days from various causes, such as a change in product, simplification of work, or installation of new plant facilities. Good personnel policies naturally dictate the retention of the surplus employees by transferring them to other jobs in the plant whenever possible, and seniority rules at Star Motors also demand such a procedure. This task of readjustment is made easier by job rating, because the specific job master commitments leave no room for questioning of wage rates by employees when voluntary transfers to equal or lower grades of work are made.

Intelligent use of job rating by maintenance supervisors can be made to yield payroll economies. For example, it was originally planned to have the company grounds and shrubbery cared for indiscriminately by all the porters, Class 37B. This would have added to the customary duties of a porter work of a special nature that would have required revision of the job master and would have boosted the job rating point score to the next higher labor grade. By creation of a special classification of grounds-tender, Class 37A2, however, and by assignment of only one man to these higher rated duties, the identical amount of work was done at lower cost, although using the same number of men, but without disturbing the labor grade of all the other porters who were retained in Class 37B.

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How Equipment Record Cuts Repair Time

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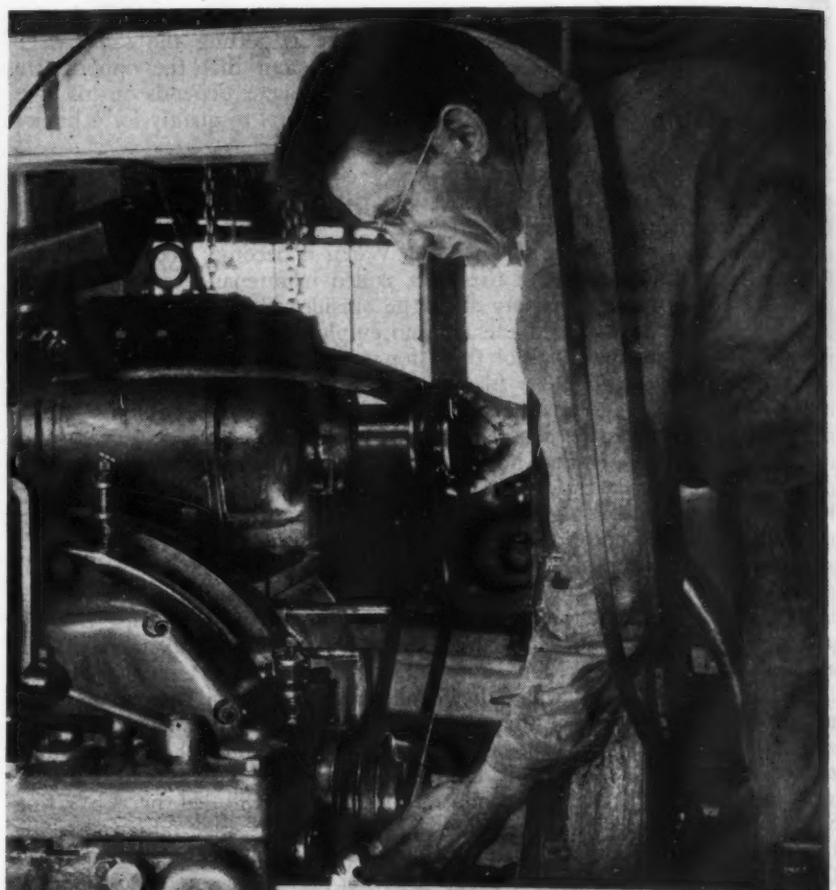
While other companies are using similar records, the wide scope of information recorded on the Conmar inventory card is responsible for its extraordinary usefulness. This card is intended not only to give a life history of the equipment it records, but also to show all important specifications needed for maintaining and servicing that equipment.

At present about 2000 inventory cards cover every item of equipment in the plant. Production machines, such as lathes, milling machines, grinders, power presses, and rolling mills, require about 1500 cards. The rest of the cards cover auxiliary apparatus such as blowers, conveyors, elevators, and boilers. Also listed on these cards are some 1000 motors ranging from 1/20 to 60 horsepower. This equipment is distributed over 250,000 square feet of floor area on five floors of a large factory building. But all working information relating to that equipment is available on the 2000 5x8-in. record cards kept in two file drawers in the plant engineer's office.



By first consulting the equipment record, belt man can respond to a call for V-belt repair fully equipped with the right replacements

A few illustrations of specific time-saving advantages will demonstrate the multiplied returns for time expended in maintenance of this record. For example, under current wartime regulations, governmental inspectors frequently call to check the various pieces of equipment. With the records in use at Conmar, it is necessary only to pull out the cards for the equipment in question, and obtain all the data required. These details usually involve size, condition, major repairs required, and the approximate operating hours.

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the line of Tube-Turn welding fittings and flanges is a complete line. Piping in distilleries, chemical plants, food processing plants, and various other industries must often be made of some special material. To meet this need we are prepared to furnish welding fittings in the metals and alloys named above. This is in addition to the regular line of standard steel Tube-Turn welding fittings and flanges of more than 4000 different kinds and sizes!

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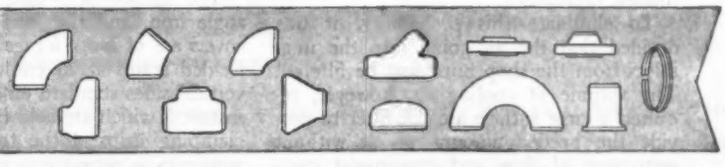

THE COMPLETE LINE OF WELDING FITTINGS AND FLANGES

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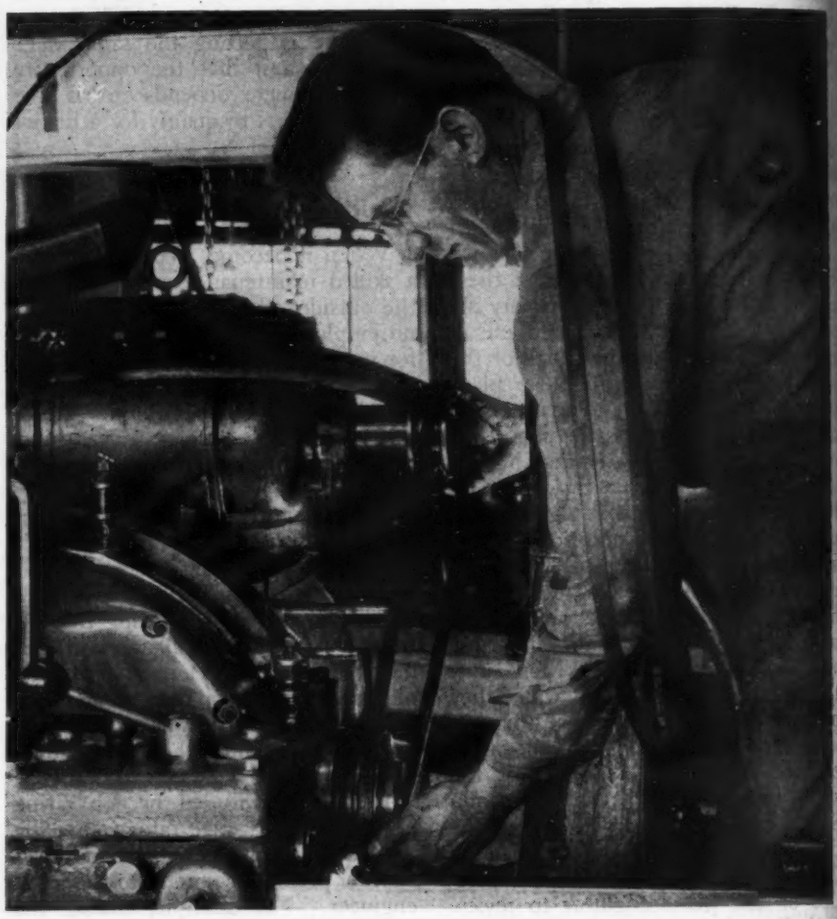

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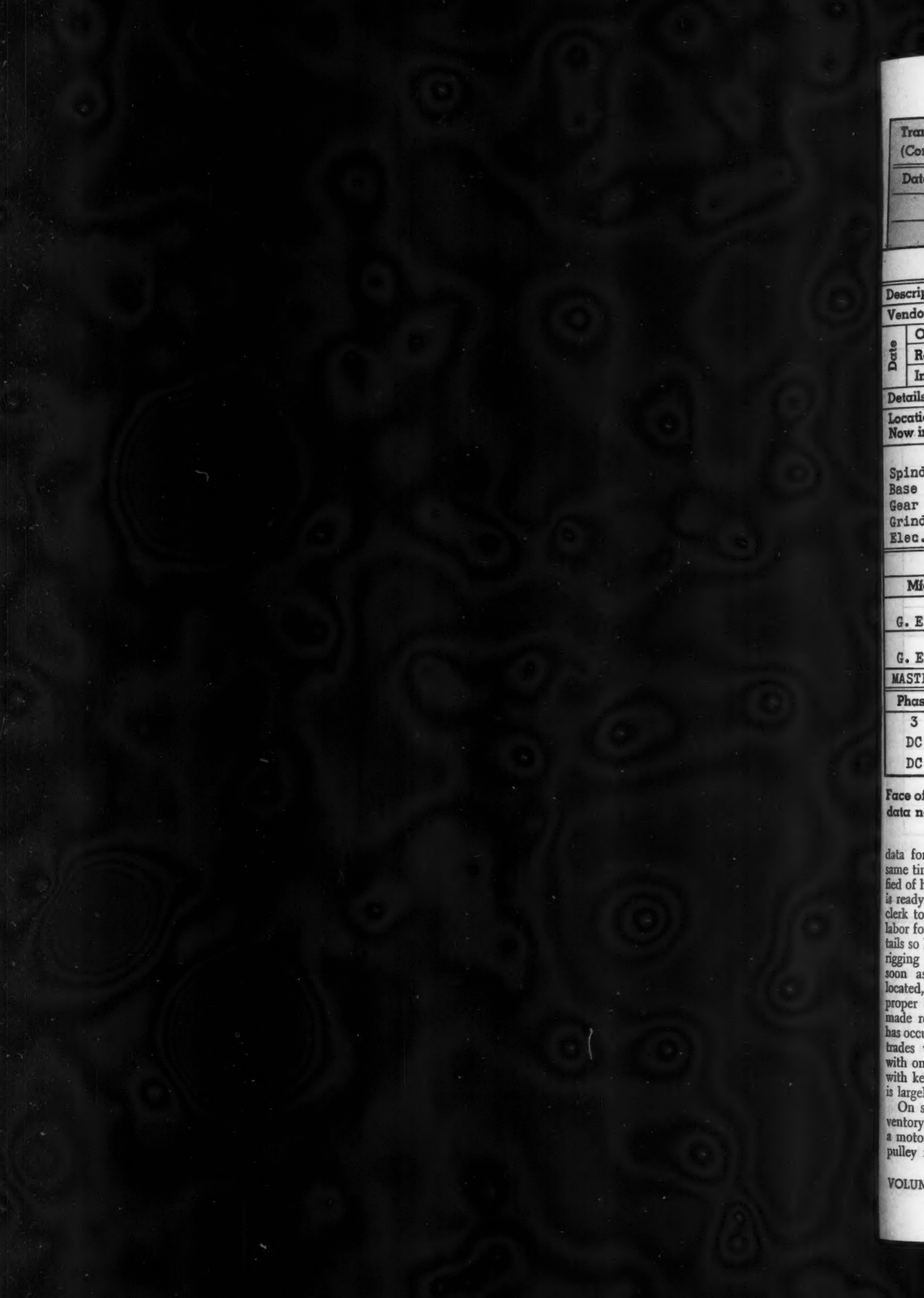


Transfer Record (Continued From Front)

GENERAL REMARKS

Pulley Data

Date To	Date	(Repairs - Overhaul - Accessories - Repaint - Parts - Etc.)	Diameter
	2-15-45	Motor #5148 overhauled and rewound	

EQUIPMENT RECORD

C-M No. 3206

Description Model TG-636 Automatic Thread Grinder		Maker Jones & Lamson	Serial No. 110564
Vendor Jones & Lamson Mach. Co.		Address Springfield, Vermont	
Date: Ordered 9-1-42	Width 10'	Weight 11,000 Lbs.	Water
Received 12-8-42	Depth 6'	Exhaust 2-6" Sq. Exhaust Ducts	Gas
Installed 12-14-42	Height 6'	Air Air Gun by Machine	Steam

Details Uses Refrigerating Unit to Cool Grinding Oil

Location T. Gage Now in Dept. #38	Transfers	Date To	Date To	Date To	Continued on Other Side of This Card

Lubrication

Spindle Bearings	3 Drip Feed-Daily
Base	1 Reservoir-(W) 4 Mos.
Gear Change Box	1 Reservoir-(W) 4 Mos.
Grinding	5 Reservoir-(W) 3 Mos.
Elec. Motor Bear.	12 Grease Gun- 4 Mos.

Bearing and Belt Data

Ball Thrust Bearings Used
MRC 5207K
ND 3207 Internal Attachment Bearings

1-2" x 28" Lg. Endless Flat Belt

MOTOR RECORD

Mfg.	HP	RPM	Type	Frame	Style	Serial No.	Model No.	Volts	Amps
G. E.	1.5	1135	K	224		XK6588	5K224D932	220/ 440	4.98/ 2.49
G. E.	5	1150/ 3450	B	284		PK217	58284A154	220	10.8
MASTER	1/8	1725	DM	2912		PA9569		230	.7

Phase	Cycle	Control Equip.	Drives	Belts	Type Bearing	Bearing Data	C-M No.
3	60	Main Cont. Bx.	Direct	Brown B-85	Ball Bearing	Federal 1305W	4224
DC	DC	Main Cont. Bx.	Direct			MRC 207MF	5148
DC	DC	Main Cont. Bx.	Direct		Ball Bearing	MRC 202	5152

Face of inventory card is used to record all important data needed by plant engineer for maintaining and servicing each item of plant equipment. Maintenance history is recorded on the back of the card

data for planning his work. At the same time, the chief electrician is notified of his part, and when the machine is ready to be moved, he requests the clerk to call the labor foreman. The labor foreman is given all necessary details so he can take with him whatever rigging is required for the move. As soon as the machine has been relocated, the clerk again notifies the proper foremen, and the machine is made ready for production. All this has occurred without workers of various trades waiting around or interfering with one another. Centralized control, with key information at its finger-tips, is largely responsible.

On small jobs, the data on the inventory cards are equally useful. When a motor is down, or a broken belt or pulley is reported, the clerk can give ratings or sizes in his instructions to prepare the maintenance man for the job he is to do.

If a bearing suddenly goes bad, the specifications on the inventory card enable the clerk to check whether one is on hand in the stockroom, and to arrange a pick-up purchase if necessary. By the time the machine has been dismantled, the new bearing is usually on hand and ready to be installed. Without the inventory card it would be necessary first to dismantle the machine, remove the old bearing to ascertain its specifications, then wait hours or days until a new bearing was obtained. By eliminating such delay, the equipment record is a definite factor in keeping downtime to a minimum, hence production at a maximum.

Proper lubrication of equipment is helped by noting the manufacturer's lubrication requirements on the inventory card. This basic information is then coordinated into a lubrication system applicable to the entire plant, whereby machines are tagged with complete instructions as to location of lubrication points, types of coded lubricants to be used, and frequency of lubrication. Furthermore, the ratio of the mix of cutting oils for specific machines is also shown on the card.

The reverse side of the inventory card, except for a few small spaces for pulley data, is devoted entirely to maintenance history. This history tells the nature and time of major repairs or overhauls, repainting, addition or replacement of accessories and parts, transfers to other locations, and average weekly hours of operation.

Use the Right Capacitor With Induction Motors

J. B. OWENS, Capacitor Engineer, Switchgear and Control Division, Westinghouse Electric & Manufacturing Company, East Pittsburgh

THE FACT that capacitors increase the current-carrying capacity of circuits supplying induction motor loads has recently led to the practice of connecting a capacitor directly to the motor terminals, thus permitting the switching of the capacitor and motor as a unit. This arrangement allows more load to be connected to the motor feeders, and the improved voltage regulation benefits motor performance, particularly on starting. No difficulties will be encountered in such applications, provided the size of the capacitor is properly chosen.

If the capacitor used with a given motor is too large, however, trouble may be encountered from the voltage generated when the motor is disconnected from the line. Under this condition the motor acts as a self-excited induction generator and may produce voltages of sufficient magnitude to damage the insulation of the motor or capacitor, or both. Also, if the motor switch is closed while the motor is operating as a generator, it is possible that a high transient torque will be produced which will damage the motor shaft or coupling.

How to Tell When

An induction motor may operate as an induction generator if its magnetizing kva. is supplied by a capacitor. Figure 1 shows the magnetizing current characteristic of a typical motor operating at rated speed. Also shown are the volt-ampere characteristics of two typical capacitors, *C1* and *C2*. The voltage of self-excitation for a given capacitor and motor is given by the intersection of the capacitor and magnetizing characteristics.

If the capacitor characteristic is above the motor characteristic, the capacitor kva. is less than the motor magnetizing requirements and no voltage will be generated. The condition is represented by the curve for capacitor *C1*. Capacitor C2 is approximately the size required to correct the full load power factor of the motor to unity. Note that the voltage of self-excitation is 150 percent of the rated voltage of the machine. This value will vary widely for different motors and may be considerably higher for some.

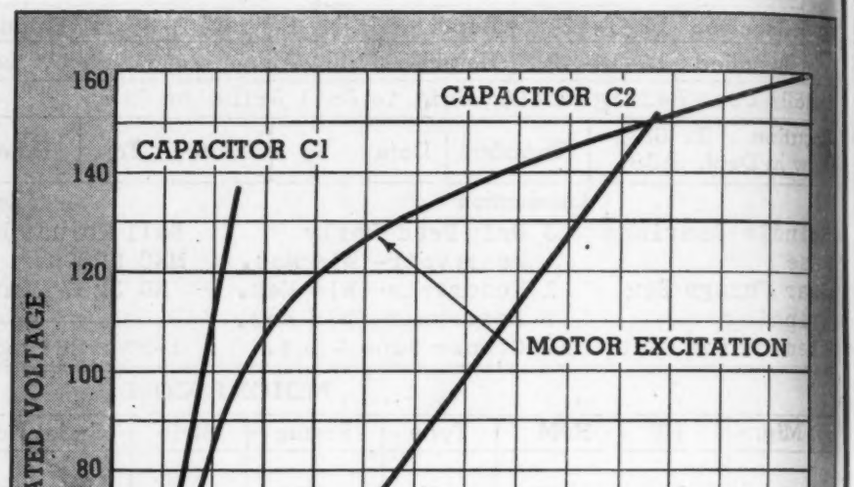
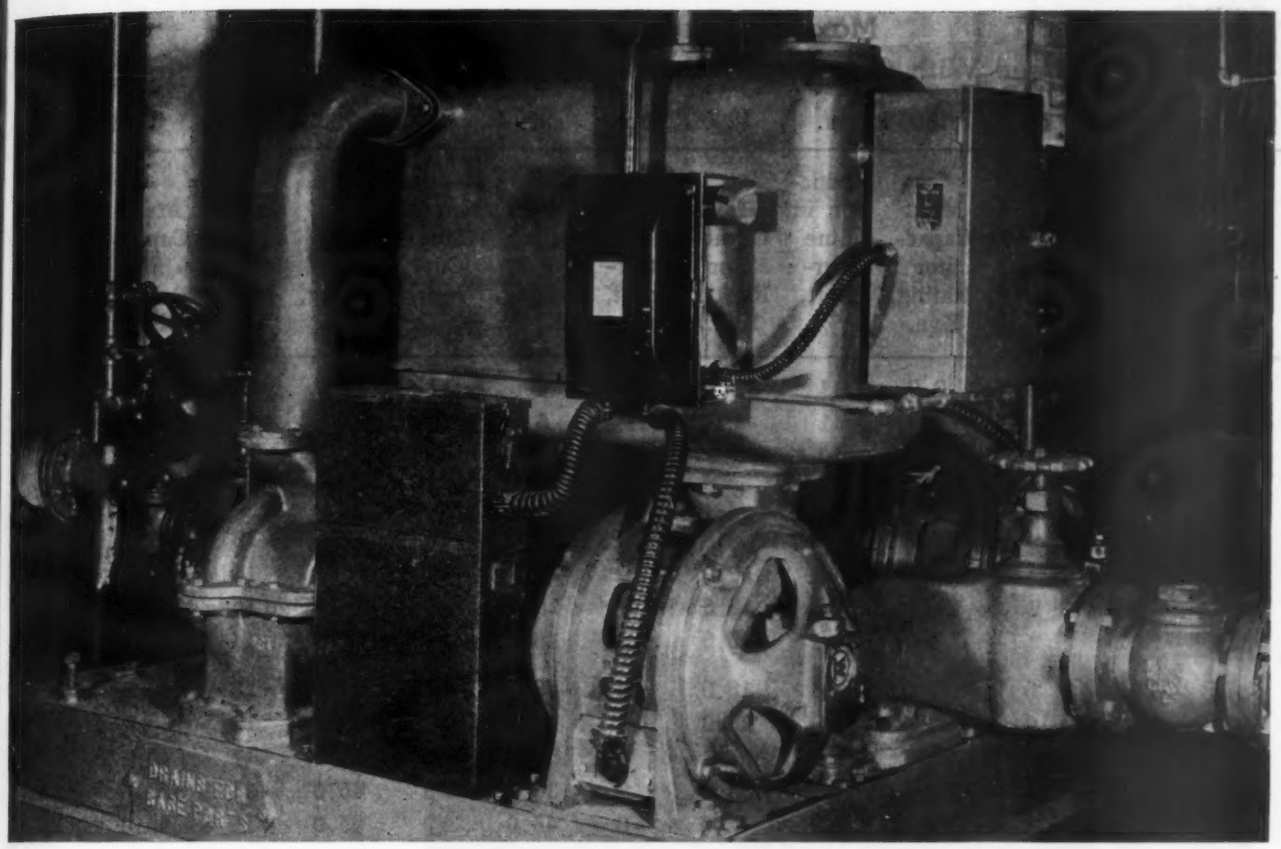


Figure 1. Curves show the magnetizing current of a typical induction motor, and capacitor volt-ampere characteristics

This graphical determination of the voltage of self-excitation assumes that the motor will remain at or near rated speed for a sufficient time after the switch is opened for the generated voltage to build up to full magnitude. The rate at which the voltage builds up is extremely rapid in most motor applications, so that the maximum voltage is very close to the value determined in this manner. A motor usually slows down rapidly after the switch is opened, and the generated voltage collapses in a few seconds. In some cases, however, as with high-inertia loads, the voltage is sustained for several minutes.

Voltages generated by induction motors operating free of the line rarely reach sufficient magnitude to puncture the insulation. Nevertheless,



Correction by an individual dust-tight capacitor was considered desirable here. The group method is preferred, however, unless there are only a few motors on the circuit, or no diversity in their use

the continued application of voltages greater than 110 percent of the rated voltage may materially reduce the life of the insulation.

Generated voltages may be dangerous even if they do not exceed the rated voltage. If a motor is operating as a generator and is connected to the line at a time when the generated voltage is out of phase with the line voltage, a high transient torque will be produced. If there is no load connected to the shaft, this torque will result merely in a momentary acceleration or deceleration of the motor. If the motor is loaded and the load inertia is high compared to that of the rotor, however, then most of the torque will be transmitted by the shaft and may do damage to the shaft and couplings.

Check Transient Torque

The table shows the maximum capacitor ratings that can be used with various sizes of motors so that substantially no self-excitation voltage will be produced. If the size of capacitor does not exceed the value given for the motor in question, no trouble is to be expected in the application, either from overvoltage or transient torque. The value of capacity shown will correct the power factor of most motors to above 95 percent, which is sufficient for most applications. The capacitor ratings given do not necessarily correspond to standard capacitor ratings, and the next lower rating should be used.

In some cases it may be desirable to use a capacitor larger than that shown in the table. In this event the voltage generated when the motor switch is opened should be measured with a voltmeter. If this voltage is greater than 110 percent of the rated voltage, the capacity must be reduced or separate capacitor switching equipment must be installed so that the capacitor can be disconnected from the motor before or at the same time the motor switch is opened, and thus prevent the possibility of trouble.

If the generated voltage does not exceed 110 percent, but does exceed 55 percent of rated voltage, it is still necessary to ascertain that there will be no dangerous torque produced in the event that the motor switch is reclosed while the motor is operating as a generator.

The maximum torque that may be produced with various values of generated voltage is shown by the chart in Figure 2. The percentage of this torque that will be transmitted by the shaft may be determined from the following expression:

$$\textit{Shaft Torque} = \frac{J_L}{J_L + J_M} T_M,$$

where J_L is the rotational inertia of the Load
J_M is the rotational inertia of the motor
T_M is the maximum torque determined from Figure 2

Most motors and shaft couplings are designed to stand an impact loading of approximately six times the rated torque. If the shaft torque exceeds this value, there is a possibility of damage.

When capacitors are connected to motor terminals, the current flowing in the line is reduced. If the capacitors are connected on the motor side of the overload protective device, this device will no longer give adequate protection if it has been selected for the uncorrected full-load current. The relay or circuit breaker must be adjusted to operate at a lower current consistent with the reduced line current.

The use of a single switch to disconnect a motor and its capacitor as a unit has become very popular because of the operating convenience and the elimination of one switching device. However, this is not necessarily the

Maximum Rating of Capacitors to Be Used With Open-Type, Three-Phase, 60-Cycle Induction Motors

	3600 R.p.m.		1800 R.p.m.		1200 R.p.m.		900 R.p.m.		720 R.p.m.		600 R.p.m.	
Motor Rating, Horse-power	Max. Capac-itor Rating, Kva.	Reduc-tion in Line Cur-rent, %	Max. Capac-itor Rating, Kva.	Reduc-tion in Line Cur-rent, %	Max. Capac-itor Rating, Kva.	Reduc-tion in Line Cur-rent, %	Max. Capac-itor Rating, Kva.	Reduc-tion in Line Cur-rent, %	Max. Capac-itor Rating, Kva.	Reduc-tion in Line Cur-rent, %	Max. Capac-itor Rating, Kva.	Reduc-tion in Line Cur-rent, %
10	2.5	9	3.0	11	3.5	12	4.5	17	5.0	23	7.0	28
15	3.5	9	3.0	11	4.5	11	6.5	16	7.5	21	9.0	26
20	5.0	9	4.0	10	6.0	11	7.5	15	8.5	20	11.5	24
25	6.0	9	5.0	10	6.5	10	8.5	14	10.0	19	14.0	22
30	7.0	9	7.0	9	8.5	10	10.0	13	12.5	18	15.5	21
40	8.5	9	8.5	9	10.0	10	12.5	12	15.0	16	18.5	19
50	11.0	9	11.0	9	12.5	9	15.0	12	18.0	15	23.0	17
60	13.0	9	13.0	8	15.0	9	18.0	11	22.0	14	26.0	16
75	17.0	9	17.0	8	18.0	8	22.0	11	27.5	13	33.0	15
100	21.5	9	22.0	8	25.0	8	29.0	10	33.0	12	38.0	14
125	25.0	9	26.0	8	29.0	8	33.0	9	40.0	11	45.0	13
150	32.5	9	32.5	8	33.0	8	36.0	9	45.0	11	52.5	13
200	40.0	9	40.0	8	42.5	8	45.0	9	55.0	10	65.0	12

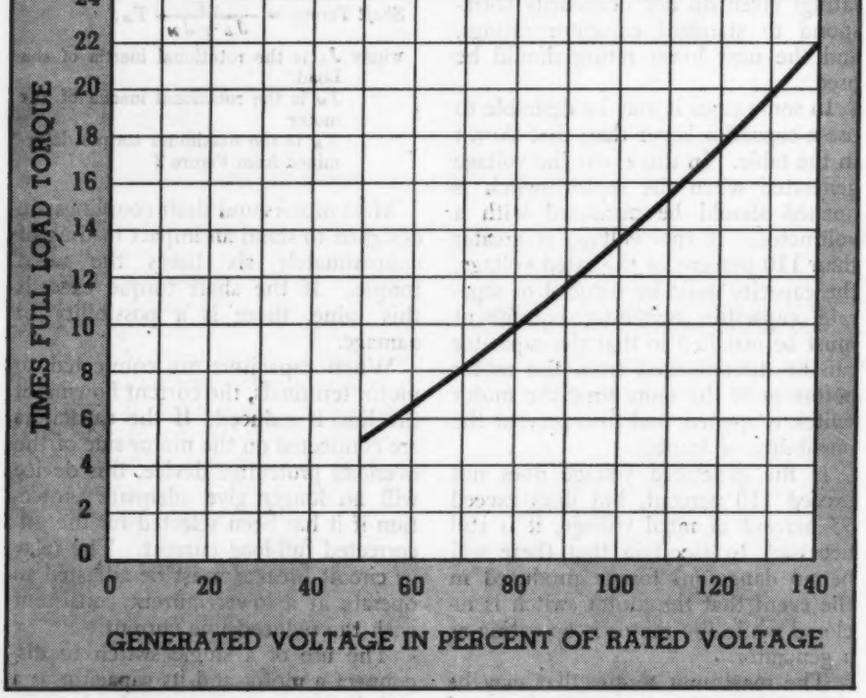


Figure 2. Maximum value of transient torque that may be produced when an induction motor operating with a capacitor as an induction generator is connected to the line

most economical method of applying capacitors. If all the motors on a given circuit are not running at the same time, it may be considerably more economical to use a group type of capacitor that is switched either manually or automatically to prevent excessive light-load voltage rise.

If capacitor units are allowed to stand idle with their associated motors while other motors on the circuit are operating with correction, there is inefficient use of the available corrective capacity.

Thus, unless there are only a few motors on a given circuit, or there is no diversity in the use of the motors, the group capacitor method is to be preferred.

The cost of switching equipment for circuits below 600 volts is usually low compared to the investment in capacitors, so that the individual method of installing capacitors is rarely economically attractive. Above 600 volts the motors are usually large and are all kept running all of the time; hence the individual method may be attractive.

Automatic switching equipment offers the same operating convenience as the individual motor method, and while it is more expensive in initial cost it may afford an over-all saving over any other method.

A Cost-Cutting Program for Perishable Tools

S. J. POWELL, Superintendent, Tool Cribs Department, Consolidated Vultee Aircraft Corporation, San Diego, Calif.

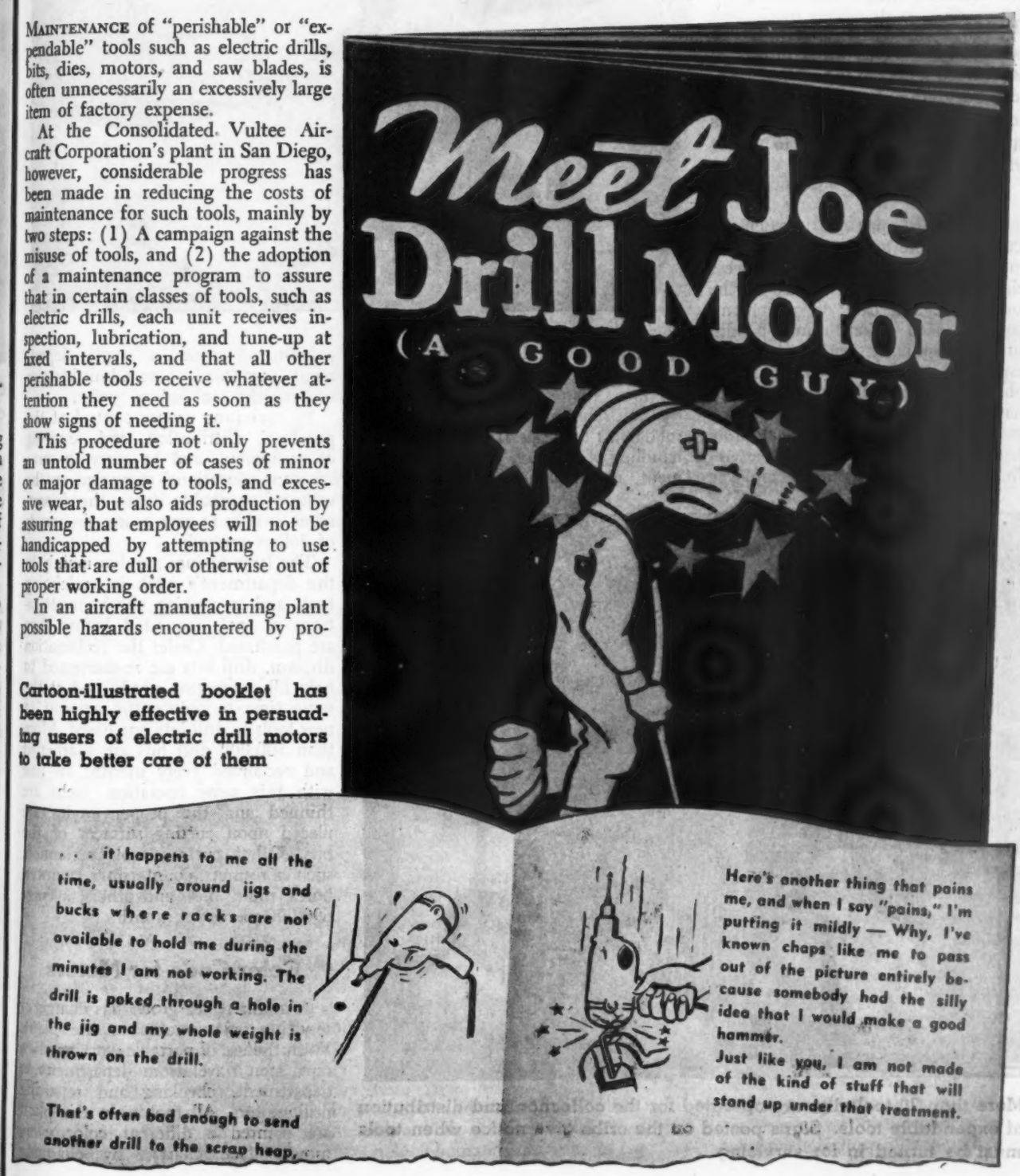
MAINTENANCE of "perishable" or "expendable" tools such as electric drills, bits, dies, motors, and saw blades, is often unnecessarily an excessively large item of factory expense.

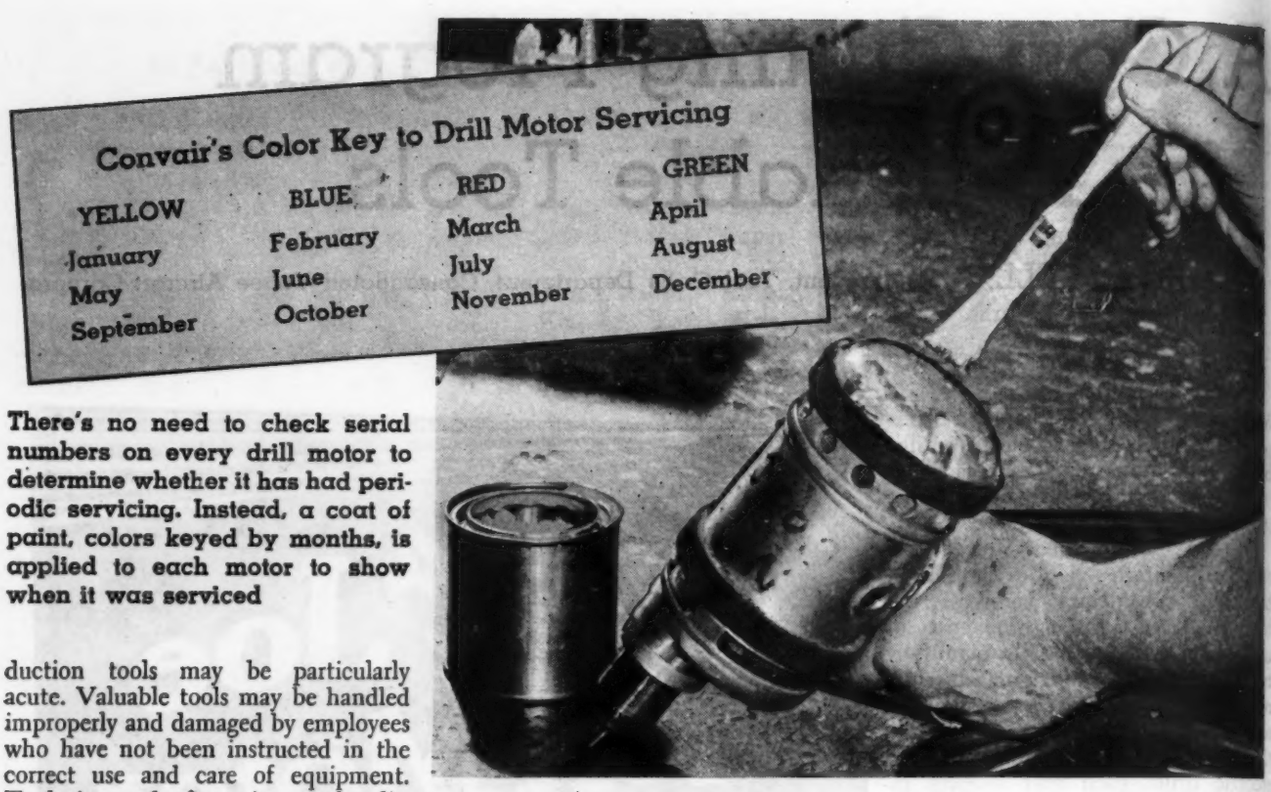
At the Consolidated Vultee Aircraft Corporation's plant in San Diego, however, considerable progress has been made in reducing the costs of maintenance for such tools, mainly by two steps: (1) A campaign against the misuse of tools, and (2) the adoption of a maintenance program to assure that in certain classes of tools, such as electric drills, each unit receives inspection, lubrication, and tune-up at fixed intervals, and that all other perishable tools receive whatever attention they need as soon as they show signs of needing it.

This procedure not only prevents an untold number of cases of minor or major damage to tools, and excessive wear, but also aids production by assuring that employees will not be handicapped by attempting to use tools that are dull or otherwise out of proper working order.

In an aircraft manufacturing plant possible hazards encountered by pro-

Cartoon-illustrated booklet has been highly effective in persuading users of electric drill motors to take better care of them


Meet Joe Drill Motor
(A GOOD GUY)
. . . it happens to me all the time, usually around jigs and bucks where racks are not available to hold me during the minutes I am not working. The drill is poked through a hole in the jig and my whole weight is thrown on the drill.
That's often bad enough to send another drill to the scrap heap,
Here's another thing that pains me, and when I say "pains," I'm putting it mildly — Why, I've known chaps like me to pass out of the picture entirely because somebody had the silly idea that I would make a good hammer.
Just like you, I am not made of the kind of stuff that will stand up under that treatment.



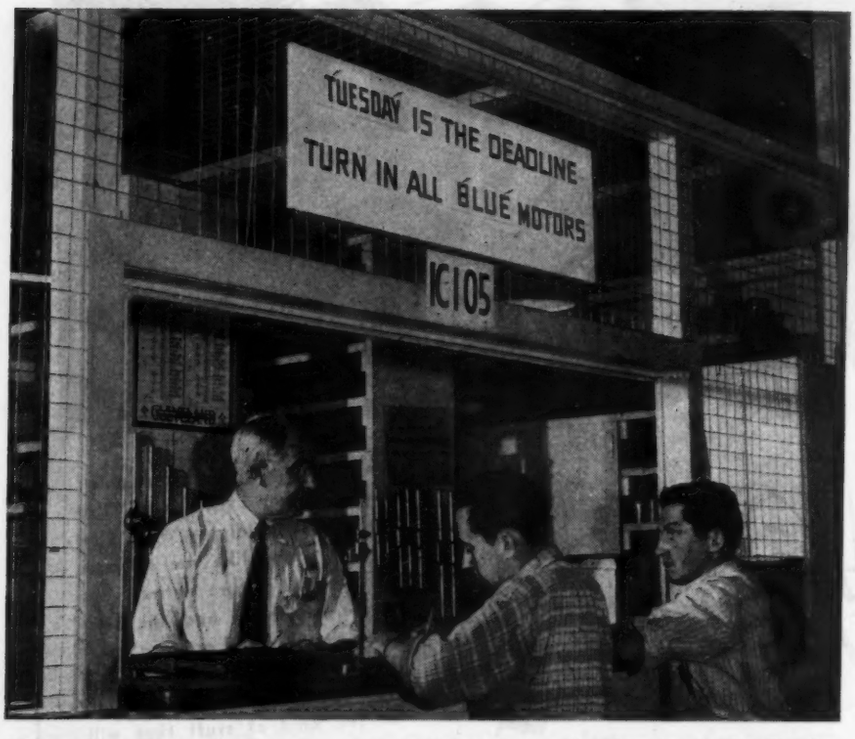
There's no need to check serial numbers on every drill motor to determine whether it has had periodic servicing. Instead, a coat of paint, colors keyed by months, is applied to each motor to show when it was serviced

duction tools may be particularly acute. Valuable tools may be handled improperly and damaged by employees who have not been instructed in the correct use and care of equipment. Tools in need of repair may be discarded temporarily, and then forgotten, when others are used for a rush job. Irregular servicing of equipment may create a large backlog of repairs and slow down production. Such problems are magnified in wartime, with thousands of unskilled employees learning to do skilled jobs in order to turn out planes.

More than 2,000,000 perishable tools are handled every month by Consolidated's toolcribs. To insure orderly handling of the large volume of equipment, all perishable tool activities are coordinated under a single department, composed of an administrative section, the tool liaison group.

By exercising proper control of the purchase, distribution, and servicing of equipment, and by carrying on a constant educational campaign on the value of perishable items, the department is able to save many thousands of dollars annually.

The large savings are due mainly to the department's work in reclaiming tools and in making check investigations of tools requested before they are purchased. Under the reclamation division, drill bits are re-sharpened to help fill production needs, and at the same time to reduce the amount of new tools or drill bits purchased. More than 500,000 drill bits are sharpened and reclaimed every month. In line with this same operation, webs are thinned and the proper angles are placed upon cutting surfaces of the bits. Other cutting tools reclaimed, such as reamers, countersinks, counterbores, rotary files, and others, average 600,000 pieces per month.



More than 70 toolcribs are operated for the collection and distribution of expendable tools. Signs posted on the cribs give notice when tools must be turned in for servicing

Color Code for Motors

A motor repair group has charge of servicing every motor in the plant. With the use of portable workbenches, repairmen travel from department to department, checking and repairing drill motors. All motors in the plant are painted a different color every month (see chart). By changing

No chances are taken of letting electric drills go too long without attention. Once a month, every drill is picked up and taken to a tool crib for inspection and other maintenance operations

colors, repairmen are able to make spot checks and ascertain readily areas that have been serviced. Approximately 5000 motors are repaired or serviced weekly. The system enables the department to service twice as many motors with half as many repairmen as were needed formerly. The same color scheme is used on torque wrenches, which are brought into department cribs regularly for repair or readjustment.

Manual Introduces "Joe"

To impress upon Convair employees the value of drill motors, and to teach them how to use drill motors correctly by showing what happens if they are handled improperly, the visual aids education section of the industrial relations department recently published a manual entitled, "Meet Joe Drill Motor." In the booklet, "Joe" is cartooned and described as an abused character, completely misunderstood by employees who use him. He plaintively explains, with the help of the cartoons, how it feels when he is thrown carelessly to the floor, his head is used as a hammer, his sensitive nose is used for prying or as a backstop to hold the weight of the drill while his nose is poked painfully through a hole. Thousands of copies of the manual have been distributed to make employes "drill motor conscious," in an effort to reduce the cost of repairs, damages, and purchases.

In the first month after the manuals were circulated, drill motor repairs decreased more than 14 percent. It is believed that repairs will drop as low as 50 percent of the former total, after use of the manuals becomes more widespread.

Displays Reduce Abuse

The toolcribs department carries on a campaign against abuse of perishable tools through charts and posters displayed in factory areas. After conspicuously posting large tool board displays in buildings for one month, the department noticed an estimated 25 percent reduction in tool maintenance costs the following month.

The boards were mounted with tools and the price of each piece of equipment was printed beneath in black letters. Signs warned employees that tool breakage costs amounted to approximately $66,000 every month. In three months, tools breakage costs decreased 50 percent. Monthly costs now average between $20,000 and $30,000. Educational placards appear on the toolcribs regularly. Pictures illustrate the proper way to use chuck keys on the drills and how to take care of per-

Promptness in making inspections, repairs, or adjustments, is one of the keystones of this company's program for reducing the costs of using and maintaining perishable or expendable tools. Portable work tables are used when tools are repaired on the job

From 600 to 1000 drill bits are resharpened daily by this crew of women. Total of expendable tools handled by all the cribs, for inspection, servicing, or repairs, exceeds 2,000,000 a month

ishable tools. They also introduce new tools that have been obtained for general use.

To handle all perishable tools, 70 toolcribs are located in factory buildings adjacent to areas requiring equipment. A main crib stores all supplies and serves as a feeder to the departmental cribs. Each crib operates according to the maximum of stock it may carry for one week. The maximum is based upon past consumption and may be arbitrarily raised or lowered, depending upon the trend in production. If any changes are made in the maximum stock list, persons concerned are notified in writing. This procedure is followed to enable the department to govern the purchase of all stock items.

Tools handled by the department include drills, reamers, taps, dies, countersinks, counterbores, chuck keys, and many others. They vary in size from the small No. 80 drills to giant riveting machines.

The cribs serve as a clearing house for all orders on standard tooling, including tools that have been declared standard within the division by the standards group. The department checks all orders for standard tooling before re-ordering. In this manner, duplications of orders are eliminated and, if possible, a tool already made and in storage may often be substituted for the one being ordered.

Take Care of Saws

Saws used in production departments are also dispatched through the cribs. More than 7000 saws are handled every month. Dispatchers pick up dull blades and deliver resharpened ones. Care is taken to make sure that each saw turned over to an employee is of the proper size and pitch.

The perishable tools manufacturing and maintenance section is concerned with the planning, scheduling, and manufacturing of tools. A design and drafting group designs all tooling in connection with riveting. For example, bucking bars for special jobs require designing and manufacturing, which are done by the group. More than 3000 different bucking bars are in use throughout the plants. Drawings are turned into finished products in a machine shop that is maintained specially for the manufacture of perishable tools.

The shop also contains a bench section where tools are assembled. A special group takes care of the maintenance of electric and pneumatic motors. Motors are picked up daily for repair, turned into the cribs and routed to the repair shop.

Check for Hose Leaks

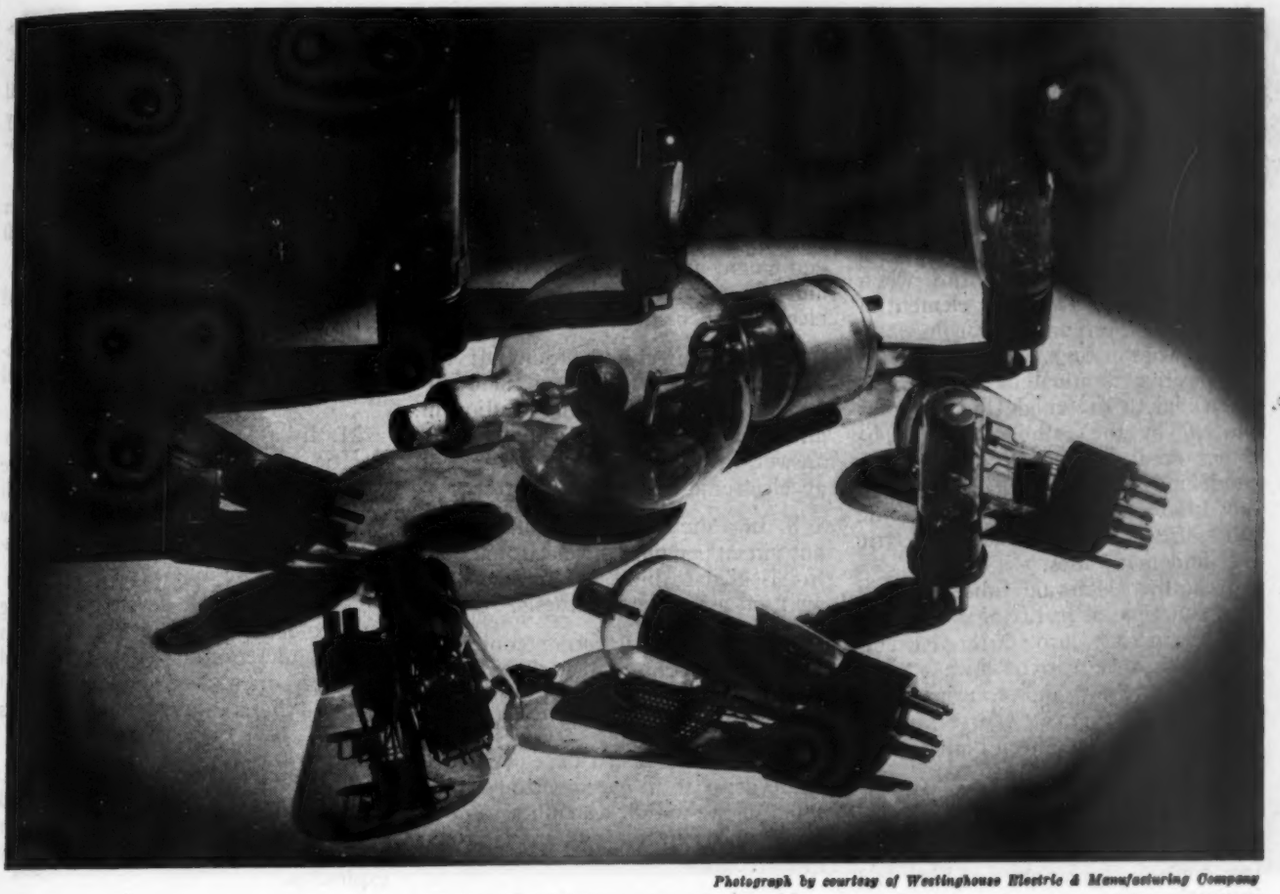
Hose leak inspectors check all production departments daily to change hoses with leaks in them. Hose repairs average 3000 per week. In one day alone, 435,000 cubic feet of air was saved as a result of repairs. Signs caution employees that compressed air is costly when used inefficiently.

Tool manufacturing and maintenance men make a daily inspection of tools in the cribs. Those in need of repair are sent immediately to the department's machine shop for necessary maintenance.

Some of the tools maintained by this group include rivet squeezers, guns, electric and pneumatic motors, general, automatic, and hydraulic riveters, as well as the riveting machines.

Because the riveting machines are extremely delicate pieces of equipment, toolcribs department representatives are assigned to all departments where the machines are located. They check the machines hourly for sharpness of punch, and supervise repairs. They also keep detailed reports on operating efficiency of the machines, which averages 98 percent, with 2 percent allowed for maintenance.

The toolcribs department keeps a perpetual inventory of every item handled by its various sections. By keeping close control on the number of tools repaired or broken, the department is able to determine into which production departments the educational campaigns should be introduced. At the same time, the inventory informs management as to the activities carried on in the department and the reductions in operating costs. All departmental functions are directed towards the goal of cutting down costs of perishable tools.



Photograph by courtesy of Westinghouse Electric & Manufacturing Company

Thirty Electronic Applications in Industry

G. A. VAN BRUNT, Associate Editor, *Factory*

ELECTRONIC DEVICES are so called because they embody an element, an electronic tube, in which electrons flow through space rather than in a wire or other conductor.

An electric current is commonly considered to represent the flow of countless numbers of electrons, which are negatively charged particles of infinitesimally small size. In motors, transformers, filament lamps, and other electrical equipment that has long been well known, the flow of electrons or current takes place in conductors made of copper or some other metal. In electronic tubes electrons are made to flow through the space separating two conductors.

Current can be made to flow through space, or jump the gap separating two cold conductors either in air or in a vacuum, if a relatively high voltage is applied. Many years ago, however, Edison discovered that if one of the conductors is heated to a high temperature, application of a very low voltage will cause a small current to flow through space, between the conductors. The reason is found in the fact that electrons can easily be detached from metals by the application of heat. Electrons may be released also by the action of light and in other ways.

In electronic tubes now in use, electrons are released by heat or light. Hence tubes are classified as thermionic and light-sensitive.

The simplest electronic tube of the thermionic type contains only two elements—a cathode and an anode. The cathode is a filament that is heated by passing current from an external source through it, and supplies electrons. The anode is a thin metal plate surrounding the cathode. Both elements are enclosed in a sealed bulb, usually glass, which may contain a vacuum, or be filled with gas at low pressure.

When the cathode is heated and the positive terminal of a battery is connected to the anode or plate, the negative terminal being connected to the cathode, part of the electrons emitted by the cathode will be attracted to the anode. Hence, a current of electricity will flow between these two elements.

In order to control the flow of electrons and adapt the different kinds of

electronic tubes for the various uses to which they are put, other elements are built into them. The fundamental principles of operation, however, are largely the same.

Light-senstive tubes differ from the simple thermionic tube described previously in that the cathode does not require heating. It is coated with some material, of which there are a number, that emits electrons when light falls on it. The other element in the tube, the anode, usually is a straight wire or ring. As before, when the positive terminal of a battery is connected to the anode the electrons emitted by the cathode when light shines on it will be attracted to the anode and a current will flow through the tube. Light-sensitive electronic tubes, frequently termed the electric eye, find many uses.

Basically, electronic tubes perform such functions as rectifying or converting alternating into direct current; amplification of current flow; control of current flow; and conversion of light into electricity. A large number of applications have been built around these functions.

On these pages are given some typical industrial applications that can roughly be classified as electronic heating; control; regulation; weighing and inspection; measurement and analysis; and safety.

These examples of applications were taken from a comprehensive survey recently made by the research department of the McGraw-Hill Publishing Company, Inc.

1. A plant that produces formed plastic parts is using with much success dielectric heating units to bring the thermosetting plastic material up to the molding temperature before it is put in the mold.

2. Use of dielectric heating has speeded up production, solved important problems, in the fabrication of thick laminated wood members, scarf splicing, and miscellaneous wood gluing operations in the manufacture of wooden aircraft skins.

3. In the compression molding of plastic parts use of a dielectric unit for preheating the thermosetting material has given one manufacturer the advantages of thorough curing of thick sections, and easier flow. Result is the possibility of molding larger pieces of more intricate design and lighter inserts.

4. A manufacturer of electrostatic condensers makes wide and successful use of induction heating equipment for soldering can tops, brackets, and other parts.

5. In a metalworking plant the presence of excessive amounts of oil mist in the air of certain departments presented a serious problem. A thoroughly satisfactory solution was found in the installation of a number of electrostatic precipitators.

6. Dust-free ventilating air for rooms housing motors and other electrical equipment in a mill that produces iron and steel products, is provided by electrostatic precipitation units.

7. A manufacturer of aircraft engines faced the problem of maintaining the desired level of the solution in an automatic plating machine. The answer was found in the installation of an electronic liquid level control.

8. In a metalworking plant turning out aircraft engines an electronic control is used to limit the travel of the work on grinding machines.

9. To control moisture content a rayon manufacturer makes use of an electronic speed control on the motors driving slashers for drying rayon.

10. Constant speed of a paper machine drive at all speed settings is assured in the mill of a manufacturer of book paper by the use of an electronic speed control.

11. Electronic registering devices on wrapping machines in a candy plant insure correct placement of wrappers on candy bars.

12. A manufacturer of metalworking machinery employs electronic control to keep the coolant oil used in grinding thread grinder screws to within 1 or 2 degrees of the temperature of the lead screw of the machines on which the grinding is done.

13. Electronic equipment is used to control temperature by the color of the flame, in processing the product of a cement plant.

14. In a heavy chemicals plant electronic devices are used to control the specific gravity of muriatic acid through operation of the valve on the water feed.

15. Automatic pH control equipment is used in a plant manufacturing explosives, to control the acid feed to treated water.

16. In a mill that produces cotton textiles an electronically operated sheet bias straightener is used on finishing range tenter frames to keep threads parallel.

17. A speed control for conveyors, based on a photoelectric cell, is used in a plant manufacturing tires, tubes, and war materials made of rubber, to maintain the proper tension and take-away in the rubber extrusion process.

18. Machine crews in a paper mill are notified by a photoelectric relay when the sheet of paper in the machine breaks.

19. A steel tubing manufacturer tests his products at rates up to 600 f.p.m. by an electronic flaw detector.

20. A photoelectric control is used on the scales in a plant that manufactures industrial chemicals, to control the weight of materials deposited in bins.

21. In a chemical plant a photoelectric control keeps track of the weight of cylinders being filled with compressed gas, and shuts off the flow when the proper amount has been introduced.

22. An electronic device for locating metal objects buried in the ground is used to determine the position and direction of underground pipes and cables, in a petroleum products refinery.

23. The concentration of inorganic matter in water solutions is measured by an electronic conductivity indicator in a plant that manufactures military explosives.

24. The boiler plant crew of a manufacturer of vegetable oil shortening and salad oils is warned by a smoke indicator whenever the density of the smoke in the stack goes above a certain point.

25. Speeds of spindles on spinning frames are checked quickly and accurately in a cotton textile mill by a stroboscope.

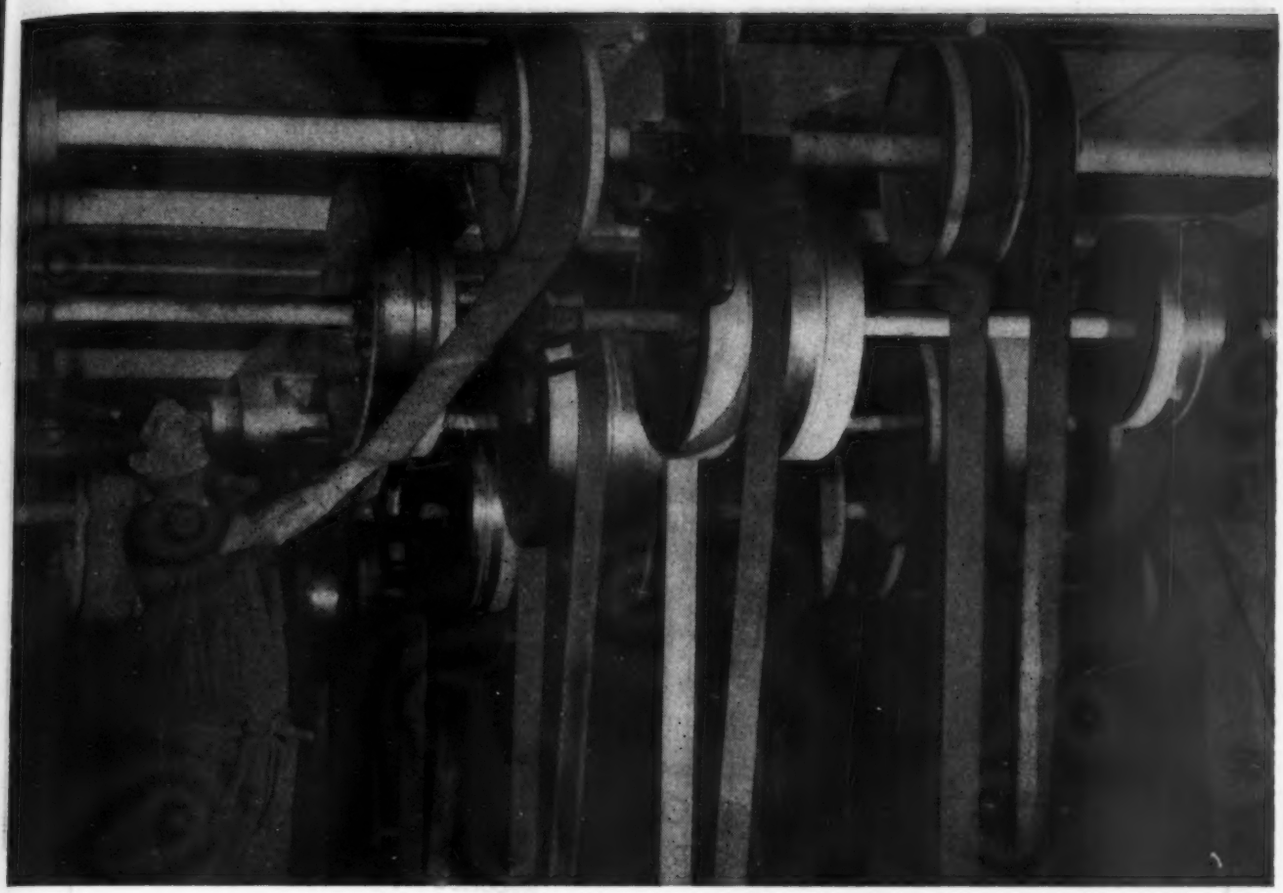
26. In a plant that produces carbon black an electronic device maintains the proper air-gas ratio by controlling the smoke density at a central point.

27. Alignment of precision machines is made easier and more exact for their manufacturer by the use of an electronic micrometer.

28. Photographs of projectiles in flight are taken by a manufacturer of firearms and ammunition with the help of a photoelectric relay.

29. Failure of oil flow in the oil-fired furnaces of a plant that manufactures parts used in ship construction causes a photoelectric relay to sound an alarm and shut off the oil supply.

30. Danger of pouring molten metal when the ladle is not in the proper position is prevented in a foundry by a photoelectric relay.



A crew of 15 oilers and belt men are responsible for keeping line shafting and belt drives in order; each man works in a certain territory, which he patrols daily, noting the condition of all drives

Endless Checking Prevents Equipment Failures

PETER A. SMITH, **Maintenance Superintendent, Winchester Repeating Arms Company, Division of Western Cartridge Company, New Haven**

THREE YEARS of round-the-clock operations without a measurable loss of production due to equipment failure. Credit for that record at Winchester Repeating Arms Company, New Haven Conn., belongs in large part to a thoroughgoing program of preventive maintenance. This program, which is rigidly enforced, is based on practically continuous checking of all important items of service equipment, supplemented by careful examinations at frequent intervals.

Carrying that program out involves a large amount of work, since a great deal of equipment is involved. Nevertheless, it has more than justified whatever it costs.

This plant comprises 175 buildings containing approximately 2,750,000 square feet of floor space. In these buildings there are 80 major manufacturing areas. To drive the production machines, which run into the thousands, and other equipment, requires more than 12,000 motors. These motors and all other electrical equipment are supplied from eight large substations located at strategic points throughout the plant. All steam and electric power is generated in the company's own power plant. Electric power is delivered to the substations at 2300 volts, three-phase, 60 cycles. In the substations it is stepped down to 440 volts and distributed at that voltage.

To provide light for production and other operations requires approximately 50,000 lighting fixtures. About 150 miles of steam piping are required for building heating and process work. Also, 125 miles of water pipe, 37 large elevators, 23 cranes, hundreds of pumps, and a vast variety and num-

CRANE INSPECTION REPORT

Tract ..... Bldg. ..... Ins. No. ..... Date .....

Make ..... Capacity ..... Crane No. .....

Main hoisting motor
Trolley travel motor
Bridge travel motor
} Airgap - brushes - grounds

Main hoist controller
Trolley travel controller
Bridge travel controller
} Resistance units-contacts-grids-lost motion

Main motor bearings
Main drum bearings
Gearing bearings
} Trolley
Bridge

Automatic stop
Dynamic brake
Bridge travel brake

Hoisting-cable-chain-hooks
Operating-chain-rope
Trolley wires-wheels-rails

Runway stops

Detailed information on reverse side

Inspector ..... Foreman .....

INSPECTION REPORT

SHAFTING AND HARNESS WORK

Date ..... Time ..... Reported by .....

Tract ..... Bldg. ..... Floor .....

Indicate location, and condition of shafting, harness work, hangers, etc., by underlining any of the following:

Jack shaft
Line shaft
Counter shaft
Shafting runs true—Yes—No
Couplings run true—Yes—No
Shaft sprung
Pulleys out of balance
Shafting out of alignment
Shafting not level
Harness work loose
Counter strap bolts loose

Hanger bolts loose
Bearing bolts loose
Cap bolts loose
Oil drip pans loose
Coupling bolts loose
Bearings cool
Bearings hot
Bearings well oiled—Yes—No
Oil ring or chain stopped
Bearings too tight
Oil hole plugged

Collar too tight
Collar too loose
Pulley slips
Key loose
Safety set screws—Yes—No
Belt trouble
Clutch trouble
Belt trap present
End of shafting safeguarded
Shafting and pulleys clean

Make additional explanations on reverse side of this report

Time ....

FOREMAN SIGN HERE

There is a minimum of paperwork in the maintenance department of Winchester Repeating Arms Company, but complete records are kept of all maintenance jobs. Illustrated are two simple, but complete, reports

ber of other kinds of equipment for whose care the maintenance department is responsible.

To handle this work, along with building maintenance and the other activities that fall to the maintenance department, requires a force of 450 men. Included in this force are 40 electricians, 46 steamfitters, 54 sheet metalworkers, 65 carpenters and millwrights, 3 masons and 6 helpers, 15 oilers and belt men, 115 janitors and housekeeping supervisors. Each group of tradesmen, of course, is supervised by a superintendent or foreman.

The conduct, and success, of the preventive maintenance program rests primarily with the supervisors. With few exceptions they have been with Winchester Repeating Arms Company for many years. During their long service they have not only become specialists in their respective

branches, but they have also acquired the intimate knowledge of the plant and equipment for which they are responsible that only many years of service can give. One important advantage of this intimate knowledge is that these men know where and with what trouble is most likely to develop, and, therefore, can watch these danger spots closely. More important, they have developed a sense of loyalty and responsibility that is invaluable. A very practical result of this sense of responsibility is the lack of need for a multitude of report forms and other kinds of paperwork in carrying on the work of the maintenance department.

Reducing Paperwork

Time was when a lot of paperwork was considered to be essential to the proper conduct of the work of this department. For example, inspectors were required to make a written report every time a piece of equipment was examined. Everything had to be put down on paper.

This is not meant to imply that the paperwork is not essential, or highly useful. It can become burdensome, however, and consume too much manpower. At one time, for example, a considerable number of men were kept busy checking inspectors' reports and keeping maintenance and inspection workers up to date. It is easy to see how that can happen when a plant has 12,000 motors, many of which are inspected daily, with corresponding amounts of other equipment.

A thoroughly practical and effective way out of this situation was eventually found by making the foremen and the members of their groups responsible for the condition of the equipment they take care of. This arrangement was found to work out very well. Therefore it was possible to cut drastically the number of reports and other forms needed.

Complete records are kept of all maintenance jobs, however. Each of such jobs is covered by an expense order, okayed by the department superintendent. A close check is maintained by a follow-up report which records the progress and completion of each repair job.

Along with this change in supervisory tactics gradually came a change in the frequency of inspection. Heretofore, inspections have been made at regular intervals. This practice has much to commend it. If the intervals between inspections are a matter of days or weeks, however, any defects or abnormalities may not be detected before they become serious, or result in a failure. This sort of thing has

One of Winchester's 12,000 motors is being reassembled. Fifteen men care for motors and their associated controls. They make sure that each motor is functioning properly and shows no signs of defects

The 37 elevators at Winchester get a daily check. They get also a thorough weekly inspection which covers every part whose failure could cause injury to personnel or damage to property

One man—a Winchester old-timer—is in charge of all pumps in the plant. He inspects as often as he deems necessary, makes any adjustments he can, reports troubles beyond his ability to remedy

happened many times at this plant, and in few instances could anyone rightfully be blamed. Hence the practice grew up of checking all important equipment daily, or even several times a day, depending on its age and condition, and the importance of the service it renders.

At present, then, some inspectors and repair men are responsible for the condition of all equipment of a certain kind throughout the plant. Other men are assigned to a certain department or area.

For example, one man, an old-timer, spends all his time looking after the pumps in the plant. He inspects them as often as he deems necessary, makes whatever needed adjustments or repairs he can, and reports any troubles that are beyond his ability to remedy.

Fifteen men are responsible for all motors and their associated controls. They check the need for lubrication, watch for excessive temperature rise, and in general make sure that each motor and its control is functioning properly and shows no signs of defects. Some motors are given this attention daily or oftener. Others get it at longer intervals, all based on the importance of the service, the severity of the operating conditions, and the age and condition of the motors. Periodically all motors are given a careful inspection, in which the insulation, resistance, condition of bearings, and other important facts are obtained.

Steam and other pipelines in the tunnels connecting the different buildings with one another, and with the powerhouse, are patrolled continuously.

Pipelines, valves, traps, all over the plant, are under virtually constant supervision all the time. Any leaks or other defects are taken care of as soon as they develop.

Elevators and cranes are two kinds of equipment whose failure may have consequences from several standpoints. Hence, they are given particular attention. Three men spend all their time on the 37 elevators. Each elevator is carefully looked over every day. Once a week it gets a thorough inspection, which covers motors, controllers, cables, doors, safety devices—every part whose failure could cause injury to personnel or damage to property.

Cranes likewise are given an inspection every day that is searching enough to insure proper operation of every element and freedom from any serious defects. At least once a month each frame gets a going over that is thorough and complete.

A considerable amount of line shafting and belt drive is used in this plant. A crew of 15 oilers and belt men are responsible for keeping this equipment in good condition. Each man works in a certain territory, which he patrols daily. He checks the lubrication of line and countershaft, and notes the condition of all belt drives.

All Equipment Checked

With minor variations in detail the same procedure is carried out with all the other kinds of equipment under the care of the maintenance department, such as transformers, circuit protective devices, air compressors. Plant buildings also are continuously watched for leaky roofs, bad spots in floors, broken windows—any condition that needs correction.

Whenever an inspector finds some condition that needs attention he immediately does whatever is necessary, if he can. If the work required is beyond his ability or facilities, he notifies his foreman. The latter then arranges to have the required work done. There is little delay, and the minimum of paperwork is involved in putting such jobs through.

The foremen of the various groups keep in close touch with their men, to make sure that the work for which they are responsible is done promptly and properly. In order to avoid as much as possible the delays that are inevitable when approvals have to be sought, maintenance foremen are given plenty of latitude in ordering repairs made or having other essential work done.

Breakage of parts and failures due to other causes cannot entirely be prevented. There is no question, however, that inspections made at the short intervals mentioned here serve to detect a great many defective conditions almost as soon as they arise, and thus make it possible to correct them before anything happens.

At least that is the way it has worked out at Winchester Repeating Arms Company.

Installing Gas Piping Systems for Safety

CLARENCE W. GRAHAM, Plant Engineer, Power Tube Division, National Union Radio Corporation, Newark, N. J.

ALTHOUGH the hazards involved in the use of gases such as oxygen and hydrogen have been well publicized, industrial accidents due to their misuse through ignorance or carelessness are still too frequent occurrences. There is no denying, however, that these and other commercial gases can be used with absolute safety if properly handled. As a consumer of substantial quantities of commercial gases, the power tube division of National Union Radio Corporation, Newark, N. J., recognizes that only by observing constant precautions in the handling of these hazardous gases can safety be assured to its employees.

Safety, then is the keyword that governs not only the design and installation of gas storage facilities and distribution piping at this plant, but also their continual maintenance and operation. Specifically, this plant uses monthly more than 400,000 cubic feet of oxygen, and about 300,000 cubic feet of hydrogen. These gases are required for various operations of glass forming and sealing in the manufacture of radio power tubes. In addition, these operations require a considerable quantity of city gas, and low-pressure air, which are mixed with the oxygen and hydrogen to obtain gases of specific processing characteristics. Another harmless gas, inert nitrogen, is used in a similar manner in monthly quantities of about 200,000 cubic feet.

Piped to Five Floors

All these gases are required for operations on all five floors and in the basement of the plant. More than 5000 feet of piping are needed to distribute oxygen, hydrogen, and nitrogen, and 3500 feet more for city gas and low-pressure air, to approximately 110 individual operating stations. In this set-up there are somewhat over 2000 valves of various kinds ranging from ¼ inch to 6 inches in size. No mention is being made of piping systems for high-pressure air, water, steam, and fire protection, also electrical conduit, other than that they add to the maze of overhead piping and naturally complicate installation and maintenance of gas piping.

Some simplification of the problem of maintenance of gas piping is obtained by painting all pipe and fittings inside the plant according to the color code of the American Standards Association for identification of piping systems. According to this code, all piping for dangerous gases is painted yellow, with fittings of red for hydrogen, green for oxygen, and yellow for city gas. Air lines are green, denoting safe gases, with fittings of yellow for low-pressure lines, and white for high-pressure lines. Nitrogen, a protective gas, is shown by bright blue lines and fittings. Supply lines outside the building, however, which originate from outdoor storage facilities for oxygen, hydrogen, and nitrogen, are painted green, red, and blue respectively to conform with each vendor's customary usage.

Oxygen and nitrogen are both supplied by storage units located in a fenced, locked enclosure in the rear parking lot of the plant. These units

After installation, all gas piping is pressure tested for leaks by applying a soap and water solution with a clean brush to each joint, valve stem, and outlet in the system. Bubbles mean leaks

consist of a number of cylindrical vessels interconnected in such a manner so as to assure an adequate supply with additional reserve capacity.

The outlet from each unit leads to a control cabinet alongside, in which are located the necessary loading, shutoff, and emergency supply valves, also the regulating valves for reduction of gas pressure from an original 2000 pounds per square inch to a distribution pressure of 50 pounds per square inch. Relief valves, set at 200 pounds per square inch, are provided, also high- and low-pressure indicating gages.

Each supply unit holds about one week's supply of oxygen or nitrogen, and is replenished regularly by the vendor. The units are electrically grounded to prevent sparks from static discharges. Actually, the design and maintenance of these units are the responsibility of the vendor. The plant's responsibility begins with the 50-lb. supply lines leading out of the control cabinets.

Safe Hydrogen Supply

Provision of a suitable, safe hydrogen supply is more of a problem. The principal hazard, in the presence of any leaking hydrogen, is that of explosive ignition by a spark or open flame. Hydrogen is delivered to the plant in the standard ICC approved cylinders, which are stored and used in an isolated 15x20-ft. sheet-metal shed located on the opposite side of the parking lot, about 100 feet from the building. The shed is kept well ventilated to prevent any possible concentration of undetected leaking hydrogen. Ventilation is helped both by open slots in the floor, which is built at truck platform height for easy loading of cylinders on and off the delivery truck, and by a vent 6 inches wide on all four sides of the building directly under the eaves.

The hydrogen cylinders are manifolded by the usual flexible copper tubing in two banks of eight cylinders each. As one bank becomes exhausted, the other bank is swung in by closing the manifold valve of the first bank and opening the second, or *vice versa*. A man must be kept in constant attendance to replenish empty cylinder banks and take care of shipments.

Only non-sparking tools are permitted in this shed for connecting and disconnecting hydrogen cylinders. Safety against sparks is further insured by installation of vapor-proof lighting fixtures and explosion-proof switches, also by a deck of insulated floor material where the cylinders are manifolded. Smoking, for obvious reasons, is prohibited.

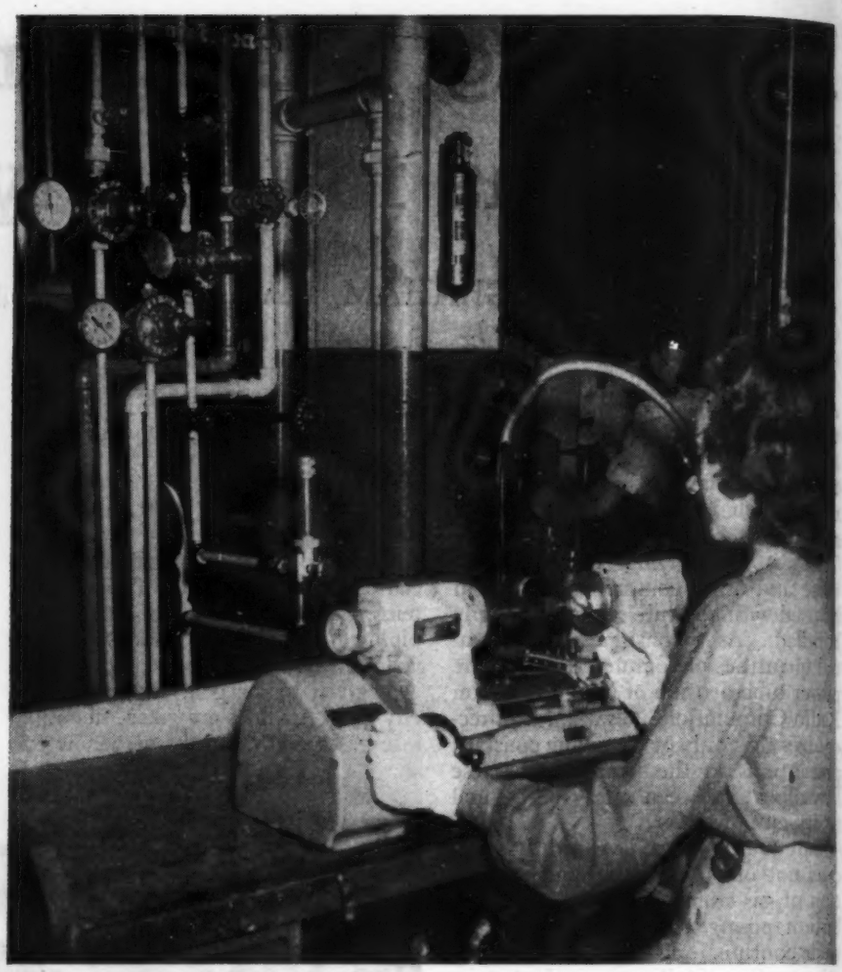
The hydrogen manifold system is equipped with regulators for reduction from the cylinder pressure of 2200 pounds per square inch to working pressures of 50 and 12 pounds per square inch. The 50-lb. line is for a special forming process; most of the hydrogen consumption is through the 12-lb. line. Both lines are equipped with fire-check valves and back-pressure relief valves to prevent any flashback or reverse flow of gas entering the main piping system.

All four outdoor gas lines, the two from the oxygen and nitrogen units and those from the hydrogen shed, are brought to the manufacturing building above the ground. These lines formerly were located underground. They were later moved several feet above ground to make frequent visual inspection possible. Moreover, the underground pipe was subject to unpredictable corrosive influences.

In each of these lines a relief valve is installed, outside the manufacturing building, which is set to pop at 75 pounds. On one occasion some dirt caused the vendor's oxygen regulator to stick. As previously stated, relief valves in the vendor's control cabinets are set for 200 pounds. Hence, when a supply pressure of 75 pounds instead of 50 pounds was noted in the oxygen line, it was discovered that the outdoor 75-lb. relief valve had been venting the surplus pressure caused by the sticking regulator.

Three of the four outdoor supply lines, at their junctions with the manufacturing building, are brought horizontally along the rear outside wall to a converge at a midway point where they rise vertically for five stories, and also drop vertically to the basement level. The fourth line, containing hydrogen at 50 pounds pressure, is directed to the basement only, where it is used for a special forming gas mixture.

At each floor, the lines containing oxygen, nitrogen, or hydrogen, are tapped off to supply the entire requirements of that floor. At every floor each line is provided with a shutoff valve just inside the building, and with a pressure gage for checking the



Operators can work safely at machines using one or more hazardous gases, such as oxygen, hydrogen, and city gas in combination with low-pressure air, when piping systems are properly installed

supply pressure. At this point each line has also a removable screen-type strainer to prevent operating difficulties caused by foreign matter or rust in the system. If any leaks occur on any one floor, that part of the system can be shut off without interrupting operations on other floors. Moreover, because the pressure relief valves are on the supply side, they can never accidentally be shut off and can always function.

Mention has already been made of the city gas and air lines. Low-pressure city gas is obtained conventionally through a meter, and boosted to 1½ pounds pressure. Air is taken from the atmosphere, filtered, and delivered in low-pressure lines for combustible purposes at 4 pounds pressure. Air at 80 pounds pressure is used for customary mechanical purposes. These pipelines originate in the basement and are brought up to all floors of the building in the customary way through floor openings. Low pressure air and gas risers are 6 inches.

All gas supply lines are run from their entrance points on each floor parallel to the depth of the building, and are located at near-ceiling height, usually below all others lines. Feeder lines branch out at right angles to equipment along the way and drop down vertically to each machine. It is not convenient to bring feeder lines up to the machines through the concrete floor because the layout of production equipment must frequently be changed. At each machine manually adjustable regulators and pressure gages are provided so that the operator is able to control the amount of gas pressure to yield the best operating characteristics for that job. Pressures of oxygen, hydrogen, and nitrogen are reduced to as low as 5 pounds at some stations.

Learned From Experience

In the preceding description of the physical layout of the gas piping systems, and in the following presentation of methods of their installation and maintenance, no attempt is being made at complete coverage. More detailed descriptions and instructions can be obtained from manufacturers of equipment and commercial gases, as was done here, for a thorough comprehension of the hazards involved. Sometimes, however, lessons are learned more forcefully, and better applications of fundamental principles are discovered, after several years' actual experience with such systems.

It has been learned, for instance, that in the installation of hazardous gas piping too much emphasis cannot be placed on the qualifications of the pipefitters. They must be skilled men, able to handle tools and materials so as to turn out a quality job. Piping systems for dangerous gases do not countenance a single mistake. One leak caused by poor workmanship may involve considerable repair expense even if discovered before any damage to life or property occurs.

All gas piping in the power tube plant, whether for oxygen, hydrogen, or nitrogen, is installed to the same specifications for materials and workmanship. This simplifies the work, and permits a single high-quality standard. Because of brass pipe and copper tubing shortages, black steel pipe of standard weight is used for working pressures under 100 pounds per square inch; on all outdoor lines extra-heavy weight is used.

Leakproof Joints

Good practice stipulates welded joints, but frequent moves of production machinery, which would require use of open torches in hazardous surroundings, prohibits this practice in this plant. The only exception is the outdoor piping, which is welded. On indoor piping, screwed joints are used, and are made tight by application of a mixture of litharge and glycerin instead of pipe joint compound. Special care must be taken not to cut threads too deeply, to avoid leaks. When unions are used, which is done as little as possible, they are of the brass-insert type with brass seats. Globe-type shutoff valves, of all-bronze or brass construction and with metallic disks and seats, are preferred, to insure tight seating. Needle point valves are used on gas lines at production equipment, however, to provide better adjustment.

Before making up pipe, valves, and fittings, they must be cleaned. When cutting and threading pipe, oil and chips are bound to fly inside. The use of carbon tetrachloride as a cleaner has advantages over the well-known method of washing in hot solution of caustic soda, in that it is just as efficient, yet easier and more quickly applied. Make sure, however, that the surrounding area is well ventilated to prevent noxious effects on workmen. To clean pipe, plug one end, partly fill with carbon tetrachloride, rock and turn the pipe for a few minutes, and pour out the solution. The threaded ends are cleaned first by wiping and then immersing in a small container of cleaning solution.

Valves must be disassembled and cleaned of all oil and foreign matter by dipping into the cleaner. This is especially important for oxygen lines, where danger of explosion exists because of the violent reaction of pure oxygen when it comes in contact with paint, oil, or grease. Remove each valve bonnet, then remove graphite and other washers, and repack with packing made of asbestos material.

Gas piping should be located where it will not be subject to accidental contact with electrical lines or moving mechanical equipment. Avoid, for instance, propinquity to belts that might break and tear down a section. No drain pitch need be observed in hanging, but it is advisable to provide drip lines on each riser to accumulate possible moisture. On oxygen and hydrogen lines, standard brass fire-checks are installed at the delivery ends of valves or venturi mixers (for several gases) to prevent any possibility of a flashback into the system.

After installation of a new line in this plant, it is checked for leaks with nitrogen gas. This inert gas has so many safety points in its favor that even were it not available as a regular supply, it would be obtained specially for that purpose. Nitrogen is introduced at 100 pounds pressure, valves are opened along the way to clear the line, and the endmost valve is kept open longer to blow out dirt. This way cleaning vapors are also eliminated.

Checked for Leaks

Finally, all valves are closed, and each joint, valve stem, and valve outlet is checked for leaks. The standard method in use here at all times is the application of soap and water solution with a clean brush. Leaks will make bubbles. Anyone using any other method is peremptorily discharged. New craftsmen are never put on this job. If a leak is indicated, it must be repaired by taking the line apart and rebuilding. Patching with cotton thread or any kind of dope is prohibited.

Sizes of pipe used in gas piping are important for obtaining adequate flow and proper flame control. When the consumption of branch outlets is known, the size of each branch, and hence that of the main supply line, can be calculated from a flow-capacity table prepared by gas manufacturers. This table indicates the volume of gas delivered at the free end of various lengths of different sizes of pipe for pressures ranging from atmospheric to 200 pounds gage.

(In a second article the author will describe how piping systems for hazardous gases are maintained in safe operating condition.)

Pumping Equipment

Pumping equipment introduced to you by *Factory* during the past 12 months is reviewed here to give you a quick one-year summary

CENTRIFUGAL PUMPS—for pumping coolants and cutting oils, are claimed to be adaptable for circulating cooling liquids, pumping or circulating water, as well as for quenching oil and general liquid transfer service. Equipped with open impeller and integral motor drive. Logansport Machine Company, Inc., Logansport, Ind. (Figure 1)

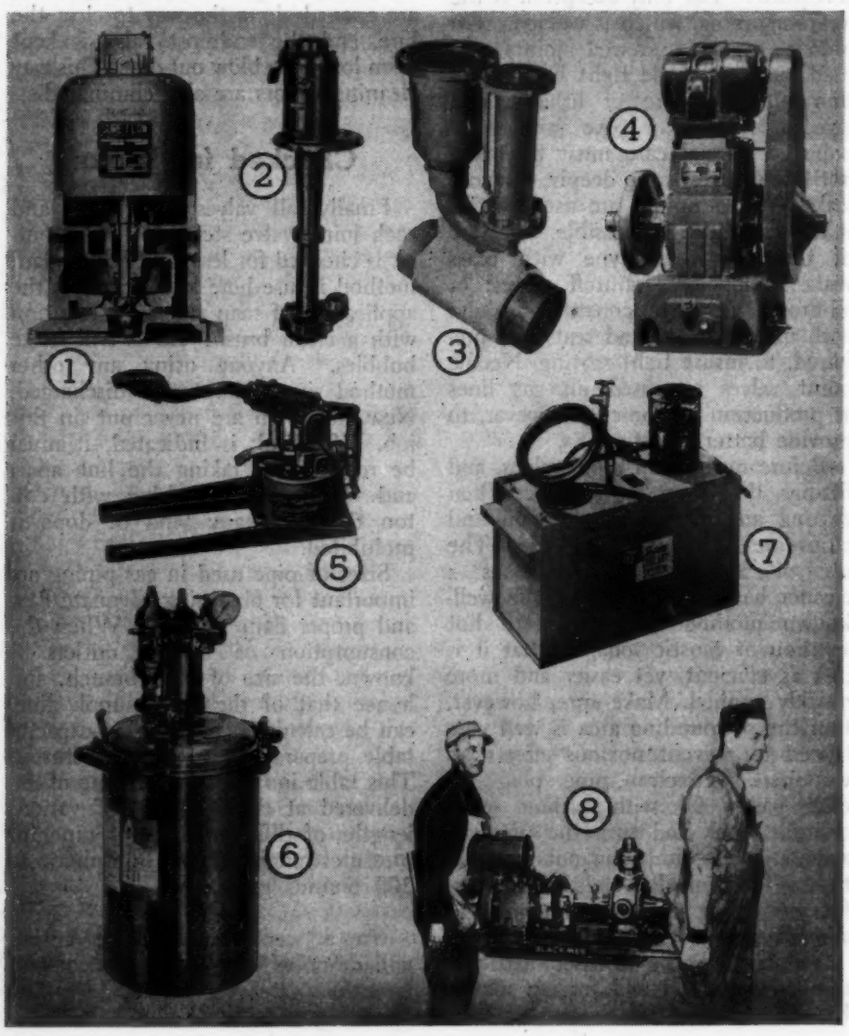
COOLANT PUMP—Gusher Model HL-5025-B deep immersion coolant pump is made in two lengths, 19- and 23-in. immersion below the high level line of coolant reservoir. Entire rotating assembly is on one-piece extended steel shaft, electronically balanced after assembly, and mounted in motor on precision ball bearings. The Ruthman Machinery Company, Cincinnati. (Figure 2)

HIGH VACUUM DIFFUSION PUMP—Against forepressure requirement of approximately 500 microns of mercury absolute, type B-8-0 industrial high vacuum diffusion pump is said to handle around 2500 cubic feet of free air per minute in pressure range of 0.1 to 0.01 microns. Has four stages of jets to give high pumping speed, and 8-in. inlet flange for large gas-handling capacity. National Research Corporation, Boston. (Figure 3)

HIGH VACUUM PUMP—No. 212 E Microvac high vacuum pump is claimed to produce and maintain vacuum as low as 5 microns absolute pressure in continuous service. Oil-sealed rotary type, pump is small, simple in design, rugged, and has high volumetric efficiency as well as large capacity. F. J. Stokes Machine Company, Philadelphia. (Figure 4)

HYDRAULIC FOOT PUMP—features automatic change of speed. Has two pistons—one high speed, low pressure; the other small, slow speed, high pressure. Maximum pressure can be pre-determined by adjustment of relief valve. Lyon-Raymond Corporation, Greene, N. Y. (Figure 5)

PAINT PUMP—R.M.S. Junior Model pump delivers paint, thinner, oils, and similar spray painting materials to the guns under controlled pressure, without use of pressure pot. Designed to supply up to five spray guns simultaneously. Stephenson Air Brush Paint Company, Oakland, Calif. (Figure 6)



PORTABLE COOLANT PUMP—Model 1100 centrifugal pump, for portable coolant system, has capacity of 1200 g.p.h. (water) at 0 head, and 360 g.p.h. at 5-ft. head. Unit can be used also for built-in coolant systems and as general purpose pump for sumps. Gray Mills Company, Evanston, Ill. (Figure 7)

PORTABLE PUMPING UNIT—Self-contained rotary pumping unit, for applications where temporary pumping facilities are needed, weighs 330 pounds, and can be carried by two men. Consists of 90-g.p.m. bronze fitted standard pump with built-in chatterproof relief valve, oil-immersed drive, and 2-h.p. gasoline engine. Blackmer Pump Company, Grand Rapids, Mich. (Figure 8)

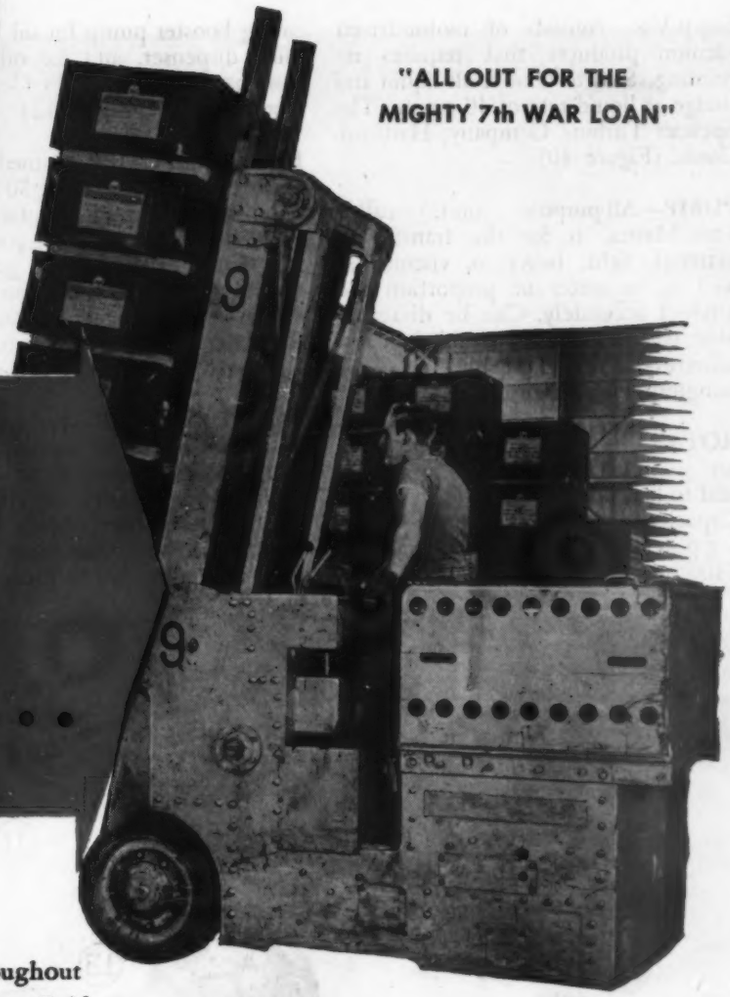
PORTABLE PUMPS—named Pinch-Hitter, may be carried in one hand and placed in operation without extra piping, having flexible hose connections. Pumps are self-priming, centrifugal, and have 110-volt motors. Larger model has capacity of 1200 g.p.h. for water solubles, 1000 g.p.h. for light oils, and 600 g.p.h. for heavy oils while smaller pump has capacity of 300 g.p.h. for water solubles, and 250 g.p.h. for light oils. Brady Pump Company, Inc., Muncie, Ind. (Figure 9)

PORTABLE SUMP TANK CLEANER—Machine, known as

EXIDE POWER

KEEPS TRUCKS HUSTLING IN TOP FORM ALL DAY LONG . . . . .

"ALL OUT FOR THE MIGHTY 7th WAR LOAN"



Sustained speeds are kept up throughout the day when electric industrial trucks are Exide-powered. They wind in and out along the warehouse highways—lifting, hauling and stacking unit loads—at savings of time and manpower, at lowered costs, and with improved efficiency.

More Exide Batteries are used to power these modern electric trucks than all other makes of batteries combined. Their abundant power enables them to handle today's greatly increased load. Extra rugged construction keeps them steadily on the job. And their ample reserves can stand the drain of continuous, day-long service. You can always count on Exides for dependability, long-life and ease of maintenance.

Write us for a FREE copy of the bulletin "Unit Loads," prepared by The Electric Industrial Truck Association. It tells how to cut handling costs up to 50% . . . covers latest developments in materials handling . . . and includes actual case histories.

ARMY E NAVY

Exide BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

Sump-Vac, consists of motor-driven vacuum producer that requires no priming. Said to remove all liquid and sludge at liquid rate of 40 g.p.m. The Spencer Turbine Company, Hartford, Conn. (Figure 10)

PUMP—All-purpose unit, called Flow-Master, is for the transfer of material, light, heavy, or viscous, as well as to meter or proportion the product accurately. Can be disassembled, cleaned, and reassembled in few minutes. Marco Company, Inc., Wilmington, Del. (Figure 11)

ROTARY PUMP—of low pressure, for pumping lubricating liquids, is said to have high volumetric efficiency. Capacity ranges proportionately from 1 g.p.m. at 600 r.p.m. to 4 g.p.m. at 2400 r.p.m. Adaptable for use as lubricating booster pump for oil lines, gasoline dispenser, and for oil pressure systems. John S. Barnes Corporation, Rockford, Ill. (Figure 12)

ROTARY PUMP—claimed capable of discharge pressures of 500 p.s.i. in handling lubricating liquids. Rated capacities of 50 and 90 g.p.m. Standard motors with separate gear reduction or gearhead motors can be used. Also available for engine drive. Blackmer Pump Company, Grand Rapids, Mich. (Figure 13)

ROTARY PUMP—for heavy-duty positive handling of liquids, has operating speeds ranging from 0 to 400 r.p.m., and capacity of 100 gallons per 100 revolutions. Made with ball bearings in both face plate and rear gear case, pump can be furnished with either flanged or threaded intake and discharge ports. Bump Pump Company, La Crosse, Wis. (Figure 14)

ROTARY PUMPING UNIT—direct-connected by flexible coupling to 1800-r.p.m. motor, has capacity of ½ g.p.m., and discharge pressure of 100 p.s.i. Available for belt drive, or rotating elements may be supplied where pump is installed. Blackmer Pump Company, Grand Rapids, Mich. (Figure 15)

ROTARY PUMPS—Vane-type rotary pumps, with capacities ranging from ⅓ to 10 g.p.m., are furnished with base and flexible coupling for direct connection to prime mover, or with V- or flat-belt drive. Blackmer Pump Company, Grand Rapids, Mich. (Figure 16)

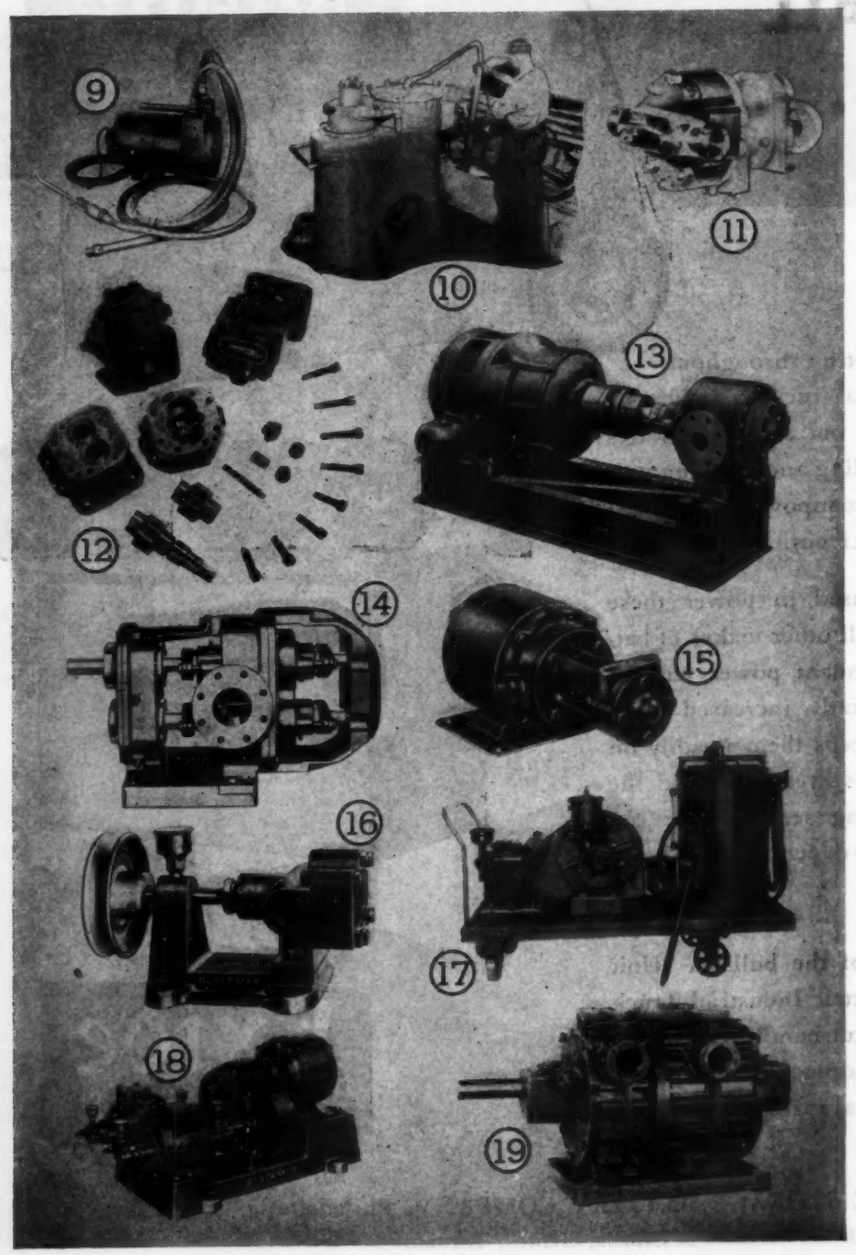
ROTARY PUMPS—of double helical or herringbone gear type, are designed to handle lubricating liquids. Made in ten sizes, ranging from the smallest with ½-in. suction and discharge, and capacity of from 1 to 1½ g.p.m., to largest, with 2½-in. connections, capacity from 50 to 75 g.p.m. Gould Pumps, Inc., Seneca Falls, N. Y.

ROTARY VACUUM PUMP—is claimed to create high degree of vacuum as well as sufficient volume of air to provide necessary power to remove liquid residue in wooden or metal industrial containers. Mounted as mobile unit, powered with electric motor or gasoline engine. Leiman Brothers, Newark, N. J. (Figure 17)

STEP-VALVE PUMP—for controlled volume pumping against negative differential pressures, unit is said to afford complete freedom from air-binding. Outside spring-loading provides ready adjustment. Milton Roy Pumps, Philadelphia.

TWIN PUMPING UNIT—of small capacity, for handling fuel oil, lubricating oil, and similar liquids, consists of two standard No. 50 pumps connected through semi-enclosed reduction gears to electric motor. Blackmer Pump Company, Grand Rapids, Mich. (Figure 18)

TWO-CYLINDER PUMP — rotary type, is used for air pressures up to about 50 pounds per square inch, and for vacuum up to about 28.7 inches mercury. While one cylinder is used for pressure, the other may be used for vacuum, or both can be used separately or in series for pressure or for vacuum. Leiman Brothers, Inc., Newark, N. J. (Figure 19)



SOMETHING NEW IN PUMP DESIGN

BEARINGS: HYATT

Emsco's new C-16 Duplex Slush Pump is distinguished by its extremely light weight but very rugged construction.

Combining high precision, great stamina and longer service life with compactness, Hyatt Roller Bearings, on main gear and pinion gear shaft, have helped make possible the design improvements and increased efficiency of this new slush pump.

If your engineers are striving for machine simplification, greater precision and maximum performance with reduced maintenance requirements, Hyatt will gladly advise on anti-friction problems.

HYATT BEARINGS DIVISION, GENERAL MOTORS CORPORATION
HARRISON, NEW JERSEY

MAINTENANCE SHORTS

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

Signboard Solves Time Clock Crowding

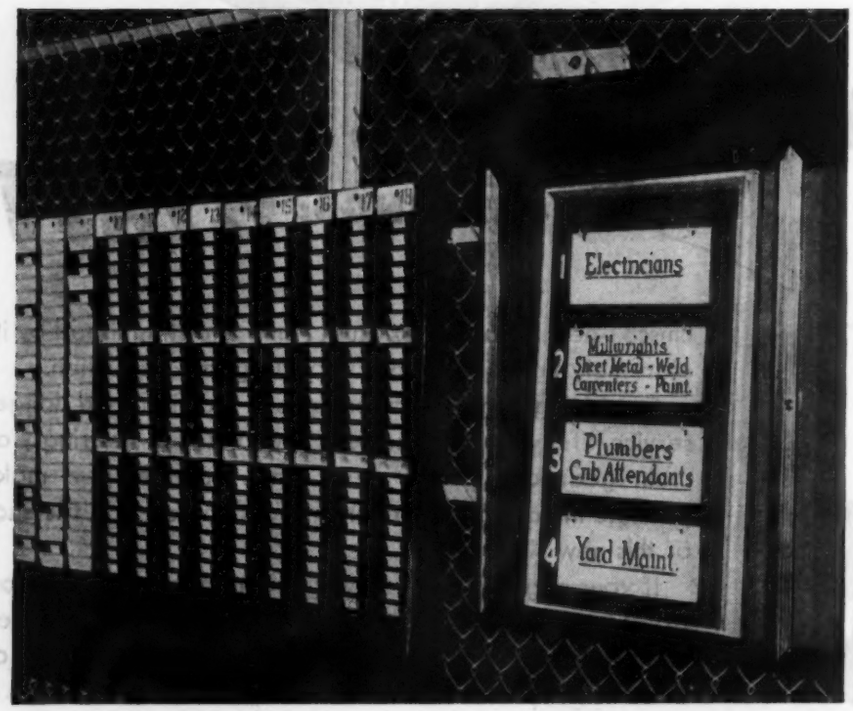
HENRY J. KREUTZINGER, Chief Maintenance Engineer, Allison Division, General Motors Corporation, Indianapolis, Ind.

When several hundred maintenance men are ready to punch out at one time clock at quitting time, there is naturally considerable crowding and shuffling around the clock unless some control is exercised. At first we attempted to eliminate such crowding by getting the men to line up, but this only transferred the difficulty from the clock to the line.

The solution was found in the voluntary cooperation by the men themselves in a plan whereby definite groups take turns in the order of going out.

Our maintenance men are divided into four main groups, headed by the millwrights, plumbers, electricians, and yard men, respectively. For each of these groups we constructed a small wooden panel, about 3 inches wide and 12 inches long. These panels are hung in a vertical row on hooks on a special board, located adjacent to the time clocks. The top position is marked number 1, and so on down to number 4, indicating the order in which the individual groups are to line up.

Each week the panels are shifted up one position, and the top panel is shifted to the bottom, thereby giving each group an equal opportunity in punching out the earliest. The men have found out that this self-disciplined control works to equal advantage, and no further supervision is needed.



There's no more milling around at the time clock, and everyone gets out faster, since panels show which group has the right-of-way. To insure equal opportunity to punch out early, panels are shifted weekly

FIFTY DOLLARS

Will be paid for the best Maintenance Short published in each issue of *Factory* until further notice. (Do not submit Shorts that deal with production processes.)

All other Shorts accepted for publication will be paid for at attractive rates.

Contributors may submit as many items as they wish. Mail yours today!

Prize-winning short this month, "Enclosure Protects M. G. Set From Shop Dust" on page 166

Paging Service Goes On After Hours

LEE F. DANN, Chief Electrician, Continental Paper Co., Ridgefield Park, N. J.

Paging executives and maintenance men by use of the plant paging system is accomplished in our plant even when the telephone operator, who usually operates the system, is off-duty.

This service has been made possible by an additional paging device that has been installed near the window of our central storeroom. During extra-shift hours this system is operated by the stores clerk on duty.

By this arrangement production men can call shift mechanics, shift electricians, or any others who have been assigned paging calls on the system, at any hour of the day or night. When called, these men report immediately to the stores clerk, who thereupon dispatches them to the department that has called.

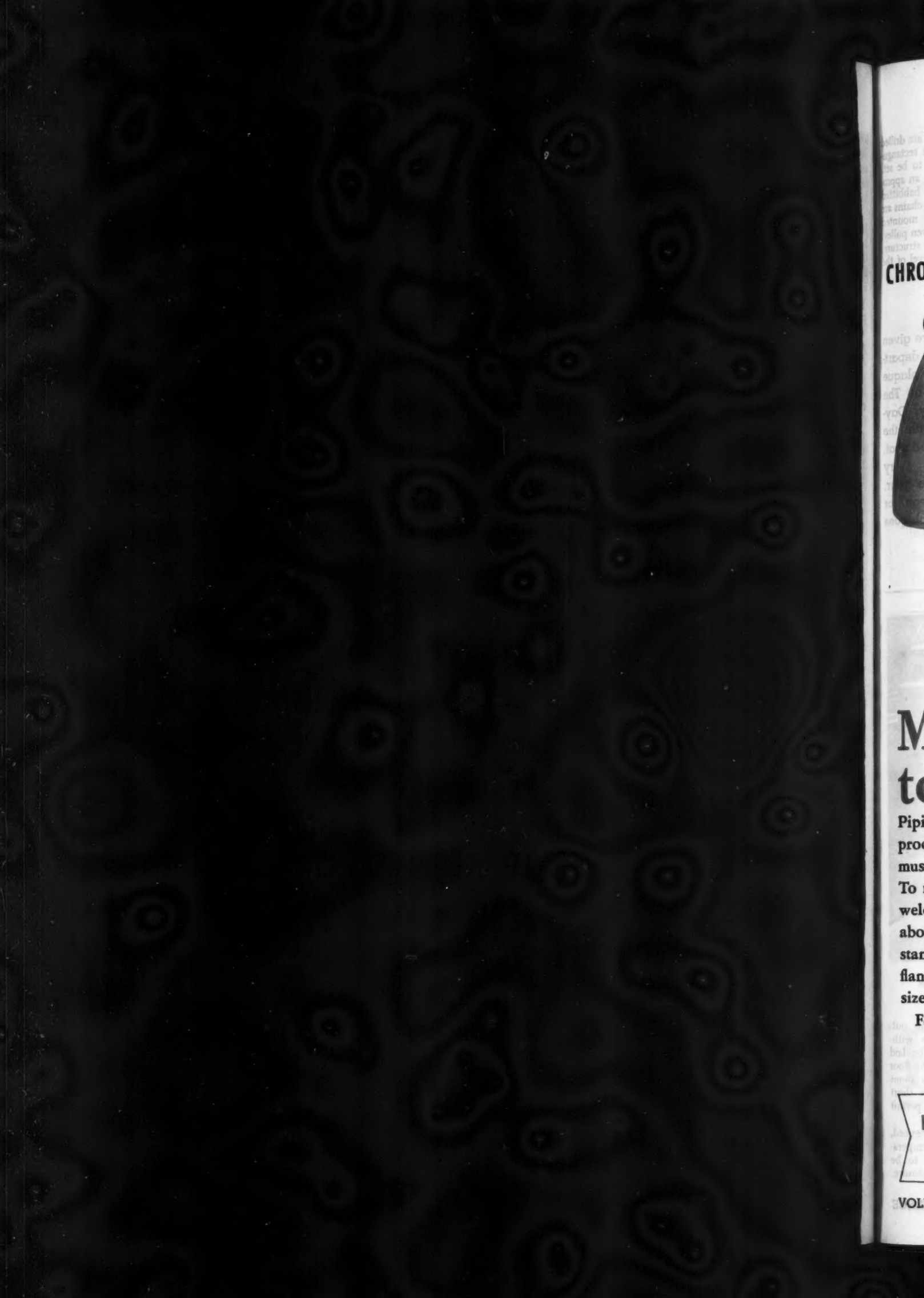
•

Relocating Motors on Concrete Floors

STEPHEN E. WELLS, Superintendent Rutland Fire Clay Company, Rutland, Vt.

Whenever it is necessary to relocate an electric motor on the floor of a reinforced concrete building like ours, there is always the possibility that the hidden reinforcing rods will interfere with the exact positioning of the bolts holding the motor base.

This difficulty is being avoided by the



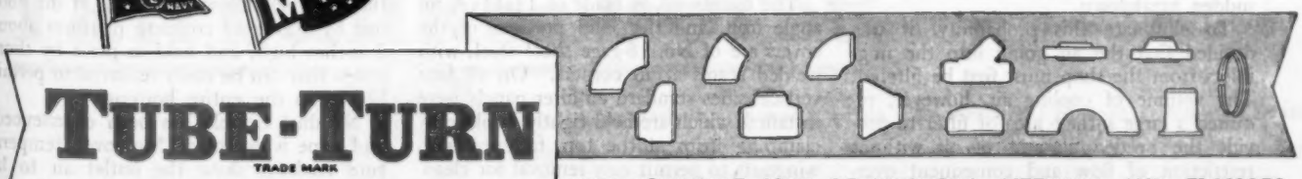
Metallurgically too,

the line of Tube-Turn welding fittings and flanges is a complete line. Piping in distilleries, chemical plants, food processing plants, and various other industries must often be made of some special material. To meet this need we are prepared to furnish welding fittings in the metals and alloys named above. This is in addition to the regular line of standard steel Tube-Turn welding fittings and flanges of more than 4000 different kinds and sizes!

For prompt helpful service in meeting your requirements, standard or special, contact the Tube-Turn distributor in your locality. He represents the line which is complete in more ways than one. He carries a comprehensive stock. He knows his business and is backed by the piping engineering experience of the organization that introduced and perfected seamless welding fittings.

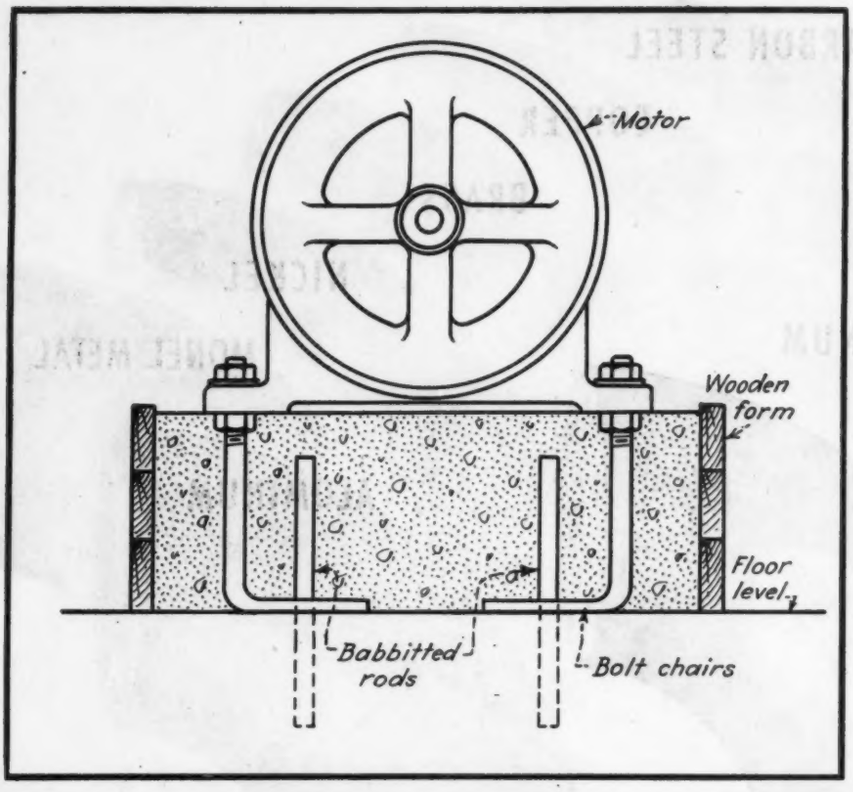
Selected Tube Turns distributors in every principal city are ready to serve you from complete stocks

TUBE TURNS (Inc.), LOUISVILLE 1, KENTUCKY.
Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle, Los Angeles.



TUBE-TURN
TRADE MARK

THE COMPLETE LINE OF WELDING FITTINGS AND FLANGES



following procedure: Four holes are drilled into the floor in any convenient rectangular pattern where the motor is to be set, and four straight rods, extending an appropriate height above the floor, are babbitted into these holes. Four steel bolt-chains are then provided, and the motor is mounted thereon and aligned with the driven pulley. A wood form is built around this structure, and filled with concrete to the level of the motor base.

•

Two free theater tickets are given to every individual in the department that wins "honor" plaque for good housekeeping at The Dayton Rubber Company, Dayton. The department with the worst record gets a life-sized goat. Plaques change hands every month. At the end of the year, departments that have won, or lost, most often, keep the plaques permanently.

•

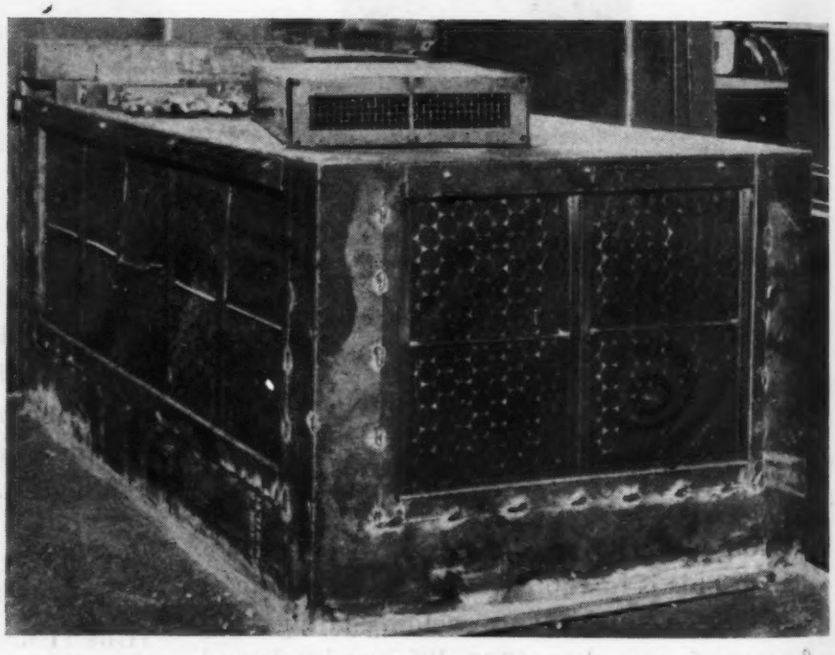
Enclosure Protects M.G. Set From Shop Dust

PETER J. JERARDI, Works Manager, The Black-Clawson Co., Hamilton, Ohio

A new 48x48-in. planer with a 20-ft. table was recently installed in the machine shop, on which control and adjustment of table speed is obtained by a d.c. motor drive with variable voltage control. This drive is powered by an auxiliary motor generator set that was furnished with the machine tool. The m.g. set is of the enclosed self-ventilated type, with motor and generator in one housing. It is ventilated by internal fan action that draws air in the housing through circular openings at both ends of the shaft. The air is exhausted through a single rectangular duct outlet brought up from the center of the unit. The air-inlet openings are provided with coarsely screened louvers that afford excellent splashproof protection, but no protection against fine-dust laden air.

It was evident from the rate of suction through the air inlets that sooner or later trouble could be expected in the m.g. set from grey-iron dust originating from surrounding machining operations. This fine dust would be drawn in and deposited on the insulated coils and moving parts, resulting in overheating and sudden breakdown.

To eliminate this probability, it was decided that the air going into the m.g. inlets from the shop must first be filtered. The volume of cooling air, however, required a large surface area of filter to provide the needed amount of air without restriction of flow and consequent overheating of the m.g. set. This problem was satisfied by the construction of a rectangular box enclosure 40 inches wide, 84 inches long, and 32 inches high.



Enclosing motor-generator set prevents dust-caused breakdowns

The framework is made of $1\frac{1}{4}$x$1\frac{1}{4}$x$\frac{1}{8}$-in. angle iron, and the solid portions of the covers are of No. 16-gage sheet steel, with welded seams at all corners. On all four vertical sides standard air-filter panels were installed, which are held tightly in place by clamping strips at the top, fastened with wingnuts to permit easy removal for cleaning and replacement. The top of the enclosure, which is flush with the air outlet, was purposely made solid to withstand the abuse of tools sure to be laid there. The enclosure is sealed at the floor line by a grouted concrete platform about 2 inches high, and held in place by short straps that can be easily removed to permit lifting up the entire housing.

No dust trouble has been experienced, and none is expected. Moreover, temperature readings show the outlet air to be just as cool as when there was no enclosure.

Complete PUMPING UNITS

. . . built, guaranteed, and serviced by ONE manufacturer

Pump illustrated is single-stage, split-case centrifugal.

Fairbanks-Morse complete pumping units offer you much more than sustained high efficiency. There are in addition these three vitally important advantages;

1. ***Combined Responsibility.*** Designed and built in one factory, pump and driver (motor or engine) are perfectly matched and covered by a single guarantee.
2. ***Successful UNIT Performance.*** Tested in one plant under expert engineering supervision, pumps and drivers assure a superior result to the buyer.
3. ***Service from One Source.*** No questions about who is to make any required repairs or adjustments.

You can get these major advantages from Fairbanks-Morse . . . because Fairbanks-Morse designs and builds all components of an outstanding line of complete pumping units. To see a qualified engineer about any pumping job, write Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Ill.

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Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

Temperature Values in Fahrenheit and Centigrade

IN THE FOLLOWING TABLES temperature values in degrees Fahrenheit and Centigrade are given from 0 to 300 degrees.

The Fahrenheit scale is commonly used by laymen to indicate temperatures, whereas the Centigrade scale usually is preferred in engineering and scientific work. It is frequently necessary or desirable to convert temperatures on one scale into those of the other.

When converting temperature readings from Fahrenheit to Centigrade, or vice versa, the following formulas are used:

$C = 5/9(F-32)$

$F = 9/5\,C + 32$, where

C and F denote the readings on the Centigrade and Fahrenheit scales, respectively.

Fahrenheit to Centigrade

(0 to 300 deg. F.)

Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.
0	−17.78	45	7.22	90	32.22	135	57.22	180	82.22	225	107.22
1	−17.22	46	7.78	91	32.78	136	57.78	181	82.78	226	107.78
2	−16.67	47	8.33	92	33.33	137	58.33	182	83.33	227	108.33
3	−16.11	48	8.89	93	33.89	138	58.89	183	83.89	228	108.89
4	−15.56	49	9.44	94	34.44	139	59.44	184	84.44	229	109.44
5	−15.00	50	10.00	95	35.00	140	60.00	185	85.00	230	110.00
6	−14.44	51	10.56	96	35.56	141	60.56	186	85.56	231	110.56
7	−13.89	52	11.11	97	36.11	142	61.11	187	86.11	232	111.11
8	−13.33	53	11.67	98	36.67	143	61.67	188	86.67	233	111.67
9	−12.78	54	12.22	99	37.22	144	62.22	189	87.22	234	112.22
10	−12.22	55	12.78	100	37.78	145	62.78	190	87.78	235	112.78
11	−11.67	56	13.33	101	38.33	146	63.33	191	88.33	236	113.33
12	−11.11	57	13.89	102	38.89	147	63.89	192	88.89	237	113.89
13	−10.56	58	14.44	103	39.44	148	64.44	193	89.44	238	114.44
14	−10.00	59	15.00	104	40.00	149	65.00	194	90.00	239	115.00
15	− 9.44	60	15.56	105	40.56	150	65.56	195	90.56	240	115.56
16	− 8.89	61	16.11	106	41.11	151	66.11	196	91.11	241	116.11
17	− 8.33	62	16.67	107	41.67	152	66.67	197	91.67	242	116.67
18	− 7.78	63	17.22	108	42.22	153	67.22	198	92.22	243	117.22
19	− 7.22	64	17.78	109	42.78	154	67.78	199	92.78	244	117.78
20	− 6.67	65	18.33	110	43.33	155	68.33	200	93.33	245	118.33
21	− 6.11	66	18.89	111	43.89	156	68.89	201	93.89	246	118.89
22	− 5.56	67	19.44	112	44.44	157	69.44	202	94.44	247	119.44
23	− 5.00	68	20.00	113	45.00	158	70.00	203	95.00	248	120.00
24	− 4.44	69	20.56	114	45.56	159	70.56	204	95.56	249	120.56
25	− 3.89	70	21.11	115	46.11	160	71.11	205	96.11	250	121.11
26	− 3.33	71	21.67	116	46.67	161	71.67	206	96.67	251	121.67
27	− 2.78	72	22.22	117	47.22	162	72.22	207	97.22	252	122.22
28	− 2.22	73	22.78	118	47.78	163	72.78	208	97.78	253	122.78
29	− 1.67	74	23.33	119	48.33	164	73.33	209	98.33	254	123.33
30	− 1.11	75	23.89	120	48.89	165	73.89	210	98.89	255	123.89
31	− .56	76	24.44	121	49.44	166	74.44	211	99.44	256	124.44
32	0.	77	25.00	122	50.00	167	75.00	212	100.00	257	125.00
33	.56	78	25.56	123	50.56	168	75.56	213	100.56	258	125.56
34	1.11	79	26.11	124	51.11	169	76.11	214	101.11	259	126.11
35	1.67	80	26.67	125	51.67	170	76.67	215	101.67	260	126.67
36	2.22	81	27.22	126	52.22	171	77.22	216	102.22	261	127.22
37	2.78	82	27.78	127	52.78	172	77.78	217	102.78	262	127.78
38	3.33	83	28.33	128	53.33	173	78.33	218	103.33	263	128.33
39	3.89	84	28.89	129	53.89	174	78.89	219	103.89	264	128.89
40	4.44	85	29.44	130	54.44	175	79.44	220	104.44	265	129.44
41	5.00	86	30.00	131	55.00	176	80.00	221	105.00	266	130.00
42	5.56	87	30.56	132	55.56	177	80.56	222	105.56	267	130.56
43	6.11	88	31.11	133	56.11	178	81.11	223	106.11	268	131.11
44	6.67	89	31.67	134	56.67	179	81.67	224	106.67	269	131.67

(Continued on page 170)

A die of Crucible's "Airdi" #150 steel (Chrome-moly-vanadium) goes into the Vapocarb-Hump Hardening Furnace at McGraw Electric Co. Right: Hardened and Homo-tempered die.

NO SCALE...NO DECARB...IN TOASTMASTER'S VAPOCARB-HUMP HEAT-TREAT

This coining and blanking die is typical of the dies and die parts being hardened by the Vapocarb-Hump Method and tempered by the Homo Method at Toastmaster Products Division of McGraw Electric Company, Elgin, Illinois. The die's smooth surface and carefully-controlled structure are typical of *all* parts treated in L&N all-electric furnaces.

There's no guesswork in these methods — all variables are under control. In the Vapocarb-Hump, protective Vapocarb gas completely envelops the work and refuses to allow soft spots due to vapor pockets or adherent scale. A Micromax Recording Controller prevents the normal furnace head (normal temperature difference between work and furnace) from being exceeded; it reduces the heat when work enters the critical — increases it later as desired.

The findings of two thermocouples — one detecting *work* temperature, the other detecting *furnace* temperature—appear on the chart of the Micromax Recording Controller. This complete temperature picture, plus the location of the critical range, enable the heat-treater to heat accurately and to find the quench point which will give "perfect" surface, correct structure, and long tool life.

An L&N engineer will gladly see you regarding a specific heat-treating problem, or will send a Catalog, as you prefer.

Companion to the Vapocarb-Hump, this L&N Homo-Tempering Furnace is a quick, clean, and accurate means of stress-relieving hardened parts. The furnace comes to temperature rapidly—has a large capacity. The heat-treater simply sets the Micromax Controller for the temperature which will give best results.

LEEDS & NORTHRUP COMPANY, 4909 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad T-620(19)

MAINTENANCE SERVICES · DATA SHEET No. 127

Temperature Values in Fahrenheit and Centigrade *(Continued from page 168)*

Fahrenheit to Centigrade *(Continued)*

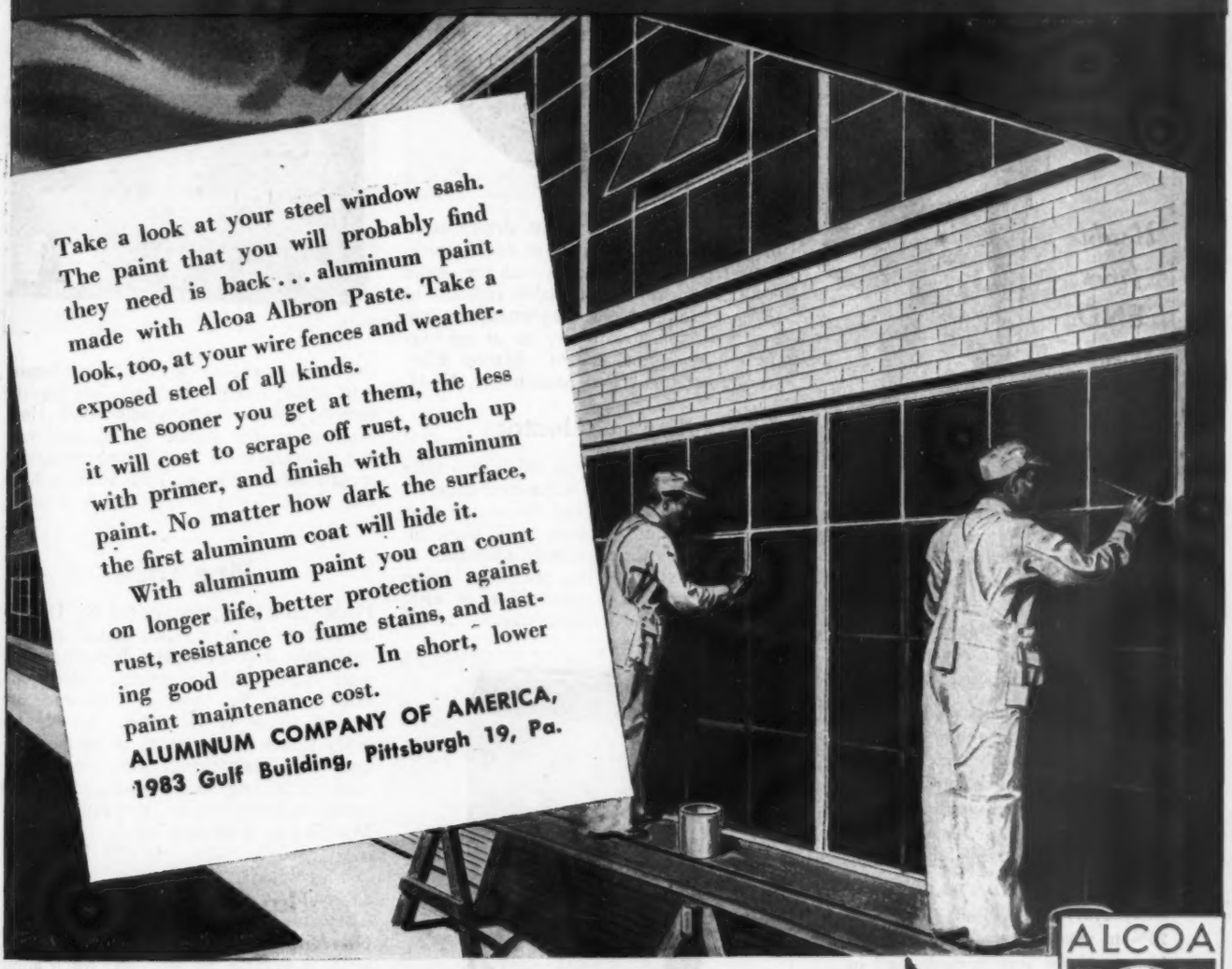
Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.
270	132.22	275	135.00	280	137.78	285	140.56	290	143.33	295	146.11
271	132.78	276	135.56	281	138.33	286	141.11	291	143.89	296	146.67
272	133.33	277	136.11	282	138.89	287	141.67	292	144.44	297	147.22
273	133.89	278	136.67	283	139.44	288	142.22	293	145.00	298	147.78
274	134.44	279	137.22	284	140.00	289	142.78	294	145.56	299	148.33
										300	148.89

Centigrade to Fahrenheit
(0 to 300 deg. C.)

Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.	Deg. C.	Deg. F.
0	32.0	50	122.0	100	212.0	150	302.0	200	392.0	250	482.0
1	33.8	51	123.8	101	213.8	151	303.8	201	393.8	251	483.8
2	35.6	52	125.6	102	215.6	152	305.6	202	395.6	252	485.6
3	37.4	53	127.4	103	217.4	153	307.4	203	397.4	253	487.4
4	39.2	54	129.2	104	219.2	154	309.2	204	399.2	254	489.2
5	41.0	55	131.0	105	221.0	155	311.0	205	401.0	255	491.0
6	42.8	56	132.8	106	222.8	156	312.8	206	402.8	256	492.8
7	44.6	57	134.6	107	224.6	157	314.6	207	404.6	257	494.6
8	46.4	58	136.4	108	226.4	158	316.4	208	406.4	258	496.4
9	48.2	59	138.2	109	228.2	159	318.2	209	408.2	259	498.2
10	50.0	60	140.0	110	230.0	160	320.0	210	410.0	260	500.0
11	51.8	61	141.8	111	231.8	161	321.8	211	411.8	261	501.8
12	53.6	62	143.6	112	233.6	162	323.6	212	413.6	262	503.6
13	55.4	63	145.4	113	235.4	163	325.4	213	415.4	263	505.4
14	57.2	64	147.2	114	237.2	164	327.2	214	417.2	264	507.2
15	59.0	65	149.0	115	239.0	165	329.0	215	419.0	265	509.0
16	60.8	66	150.8	116	240.8	166	330.8	216	420.8	266	510.8
17	62.6	67	152.6	117	242.6	167	332.6	217	422.6	267	512.6
18	64.4	68	154.4	118	244.4	168	334.4	218	424.4	268	514.4
19	66.2	69	156.2	119	246.2	169	336.2	219	426.2	269	516.2
20	68.0	70	158.0	120	248.0	170	338.0	220	428.0	270	518.0
21	69.8	71	159.8	121	249.8	171	339.8	221	429.8	271	519.8
22	71.6	72	161.6	122	251.6	172	341.6	222	431.6	272	521.6
23	73.4	73	163.4	123	253.4	173	343.4	223	433.4	273	523.4
24	75.2	74	165.2	124	255.2	174	345.2	224	435.2	274	525.2
25	77.0	75	167.0	125	257.0	175	347.0	225	437.0	275	527.0
26	78.8	76	168.8	126	258.8	176	348.8	226	438.8	276	528.8
27	80.6	77	170.6	127	260.6	177	350.6	227	440.6	277	530.6
28	82.4	78	172.4	128	262.4	178	352.4	228	442.4	278	532.4
29	84.2	79	174.2	129	264.2	179	354.2	229	444.2	279	534.2
30	86.0	80	176.0	130	266.0	180	356.0	230	446.0	280	536.0
31	87.8	81	177.8	131	267.8	181	357.8	231	447.8	281	537.8
32	89.6	82	179.6	132	269.6	182	359.6	232	449.6	282	539.6
33	91.4	83	181.4	133	271.4	183	361.4	233	451.4	283	541.4
34	93.2	84	183.2	134	273.2	184	363.2	234	453.2	284	543.2
35	95.0	85	185.0	135	275.0	185	365.0	235	455.0	285	545.0
36	96.8	86	186.8	136	276.8	186	366.8	236	456.8	286	546.8
37	98.6	87	188.6	137	278.6	187	368.6	237	458.6	287	558.6
38	100.4	88	190.4	138	280.4	188	370.4	238	460.4	288	550.4
39	102.2	89	192.2	139	282.2	189	372.2	239	462.2	289	552.2
40	104.0	90	194.0	140	284.0	190	374.0	240	464.0	290	554.0
41	105.8	91	195.8	141	285.8	191	375.8	241	465.8	291	555.8
42	107.6	92	197.6	142	287.6	192	377.6	242	467.6	292	557.6
43	109.4	93	199.4	143	289.4	193	379.4	243	469.4	293	559.4
44	112.2	94	201.2	144	291.2	194	381.2	244	471.2	294	561.2
45	113.0	95	203.0	145	293.0	195	383.0	245	473.0	295	563.0
46	114.8	96	204.8	146	294.8	196	384.8	246	474.8	296	564.8
47	116.6	97	206.6	147	296.6	197	386.6	247	476.6	297	566.6
48	118.4	98	208.4	148	298.4	198	388.4	248	478.4	298	568.4
49	120.2	99	210.2	149	300.2	199	390.2	249	480.2	299	570.2
										300	572.0

THINGS ARE LOOKING BRIGHTER

Catch up on rust and grime with *Aluminum Paint*



Take a look at your steel window sash. The paint that you will probably find they need is back . . . aluminum paint made with Alcoa Albron Paste. Take a look, too, at your wire fences and weather-exposed steel of all kinds.

The sooner you get at them, the less it will cost to scrape off rust, touch up with primer, and finish with aluminum paint. No matter how dark the surface, the first aluminum coat will hide it.

With aluminum paint you can count on longer life, better protection against rust, resistance to fume stains, and lasting good appearance. In short, lower paint maintenance cost.

ALUMINUM COMPANY OF AMERICA,
1983 Gulf Building, Pittsburgh 19, Pa.

This means 99+ . . . assures better Aluminum Paint

Best results are given by aluminum paint that is made with high grade pigment. Use Alcoa Albron, made from 99+% pure aluminum.

ALCOA ALUMINUM

ALBRON

ALCOA ALBRON PASTE IS MADE UNDER PATENTS OF THE METALS DISINTEGRATING COMPANY, INC.

Johnson
UNIVERSAL
Bronze Bars

Usable from **END** *to* **END**
No Waste
No Scrap

● Time is a precious commodity. Industry has constantly sought ways to save it . . . to make each hour more productive. One easy way is to make each machine . . . every motive unit as efficient as possible.

The first step is to check the bearings. Find out if they are helping each unit to operate at top efficiency . . . for the longest period of time. When replacement is necessary . . . try Johnson UNIVERSAL Bronze. There is no higher quality available.

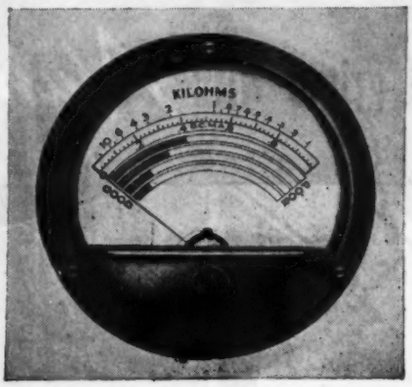
Every Johnson UNIVERSAL Bar is *completely machined.* This saves 25% in weight and guarantees perfection all the way through. Call in your local Mill Supply house and let him show you how Johnson UNIVERSAL Bronze will save you time and money.

JOHNSON BRONZE
512 SOUTH MILL STREET
NEW CASTLE, PENNA.

WHAT'S NEW IN EQUIPMENT

Electric Meters

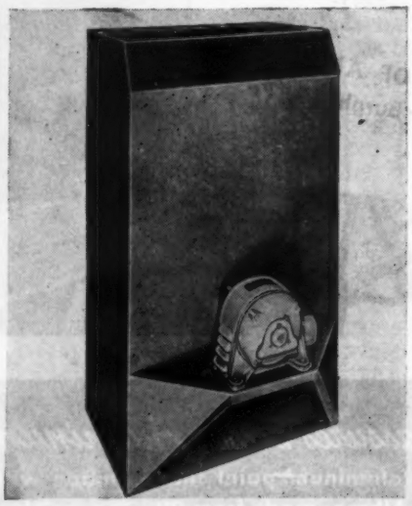
Hermetically sealed 2½- and 3½-in. electric indicating instruments are announced. Mechanism is built into protective cup-like frame, and the glass cover is sealed to metal rim. There are no rubber gaskets or cement seals. Sealing is claimed to be effective under severe tropical as well as



freezing conditions without deterioration of the seals. Windows are of double-thickness, tempered glass, processed for solder sealing, and said to be highly resistant to shock. Completely dehydrated, instruments are filled with dry air at sea-level pressure. All d.c. ranges. Marion Electrical Instrument Co., Manchester, N. H.

Dust Collector

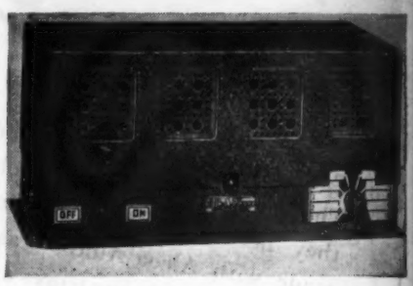
Reducing the ratio of air volume to filter surface area, Tubular Dustex dust collector is claimed to collect and retain any type of dust or lint. Comes in 3 sizes, all portable and self-contained, adaptable to requirements of buffing machines. Large unit contains 48.8 square feet of filter surface area that lessens volume of air



drawn through any portion of filter at one time, preventing minute particles from filtering through. Also diminishes static pressure loss. Filtered air is discharged through large muffler to deaden air noise. Collector maintains a static air pressure of more than 4 inches at a velocity of over 5000 l.f.m. Dust Filter Co., 160 North La Salle St., Chicago.

Power Booster

The HP-16 power booster enables the executive to communicate with both office and factory without going through the central switchboard. Unit is claimed capable of delivering minimum of 15 watts voice range power, sufficient to cover the average paging system requirements. More than one booster can be used where greater power levels are necessary. Pressing one of



the buttons marked "power" throws booster into action, and the voice goes out into the factory, penetrating high noise levels. However, when the answer is received from the outlying station, it comes through at regular office volume. Talk-A-Phone Mfg. Co., 1512 South Pulaski Road, Chicago

Pipe Tape

Pliable cork-filled tape, called No Drip, is claimed to form a sealed jacket and immediately stop damaging drip from cold water pipes. Covers fittings, valves, and other parts. No tools or experience are needed to apply the tape. Suitable for pipes 1 inch in diameter, or smaller. Requires no maintenance and lasts indefinitely, according to manufacturer. Tape is brown in color, but can be painted. J. W. Mortell Co., Kankakee, Ill.

Hard-Facing Metal

Non-ferrous hard-facing metal, called Fanweld, is suitable for acetylene torch application to steel. Contains tantalum-columbium carbide that is said to impart a self-lubricating action, minimizing destructive effects of friction even at elevated temperatures. According to manufacturer, Fanweld wets steel surfaces readily without use of flux, flowing smoothly and evenly; surfaces as thin as 0.010 inch can be applied with a fusion layer as thin as 0.0005 inch. No hardening

This
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your

VOL

ARE YOU WELDING STAINLESS STEEL? HERE'S *New Light* ON THE SUBJECT

This book can save you time and avoid spoilage of vital alloys, both more than ever essential to the war program today. Describes and illustrates equipment, procedures, precautions. Request copies on your company letterhead, please.

ADDRESS DEPT. FM-33

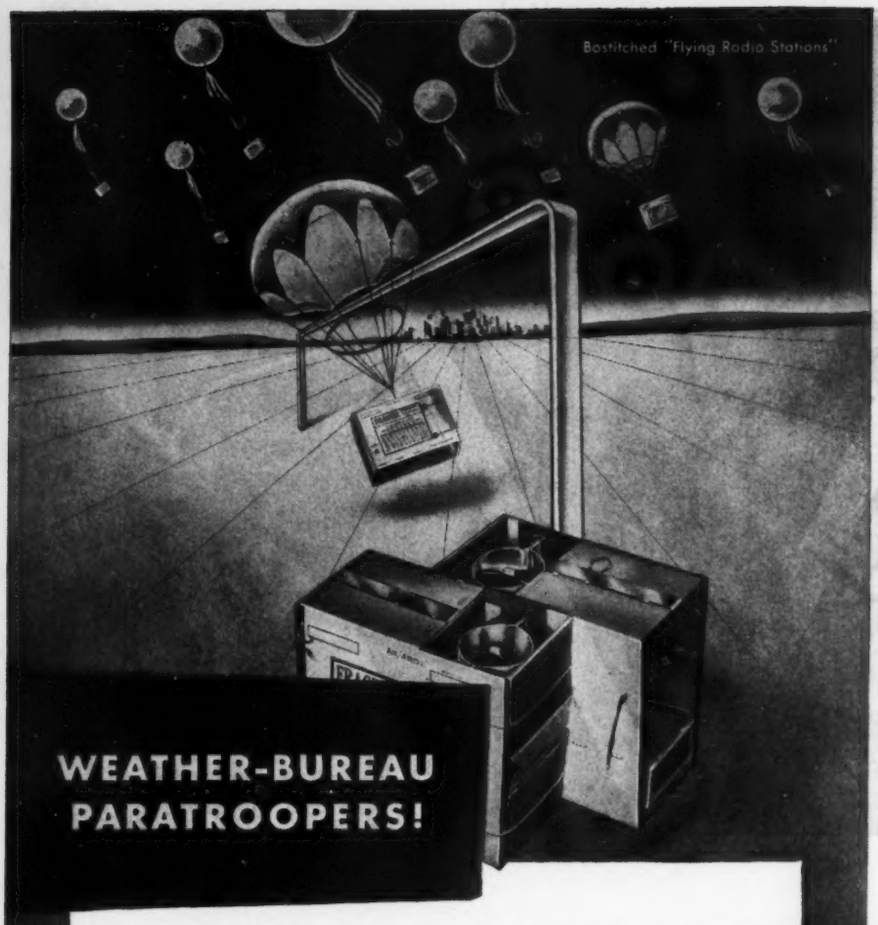
SUCCESSFUL stainless steel welding, as many a shop has found out the hard way, puts a premium not only on knowing what to do, but also what to avoid doing—and why.

That is because the problem, first of all, is a double one as compared to ordinary carbon steel welding, since it calls for maintaining the corrosion resistance of the parent metal across the weld area, as well as its strength. Furthermore, although stainless steel welds easily, the various members of the stainless family differ considerably from carbon steel—and even from each other—in the physical and chemical phenomena they exhibit during the welding process.

Information, clear and complete, is the basic answer. We've supplied it in a new 64-page, full-color booklet, *"Welding Stainless Steels,"* covering all the commonly-used hand or machine methods of welding Allegheny Metal. Employing a new idea in graphic illustration, this book is, we believe, the most complete and understandable coverage of the subject yet published—a welding shop "bible" purposely made so clear and simple that it is also ideal for student training. ● *Write for your copy (see at left).*

Allegheny Ludlum
STEEL CORPORATION
BRACKENRIDGE, PENNSYLVANIA

A-9078 . . . W&D



WEATHER-BUREAU PARATROOPERS!

If a package straight from the heavens lands in your yard . . . it will probably be a "radiosonde" . . . scientific aerial radio transmitter and recorder . . . balloon-borne many miles into the stratosphere . . . broadcasting basic weather information . . . until, its mission fulfilled, it is parachute-borne safely to earth. Complete instructions will be found on the package for its return . . . so that it may be sent aloft again and again.

BOSTITCHING plays a part in insuring the safe landing and the re-use of this modern miracle . . . an outstanding example of the Weather Bureau's engineering ingenuity and salvaging economy.

This use illustrates a simple, frequent Bostitch application. Whenever *you* think of fastening . . . metal, wood, plastics, paper, cloth, leather, rubber . . . in any combination . . . remember that in thousands of wartime and peacetime applications *BOSTITCH fastens it better and faster with wire.*

Bostitch field men the world over . . . specializing exclusively in stapling . . . backed by forty years' stapling experience . . . will be glad to discuss with you how Bostitch machines, when available, can help you get the best fastening results.

Bostitch (Boston Wire Stitcher Company) 72 Blackmore St., East Greenwich, R. I. (or Bostitch-Canada, Ltd., Montreal).

Bostitch Staples in most sizes are now available.

BOSTITCH

fastens it better, AND FASTER with wire

ALL TYPES OF STAPLES APPLIED BY MACHINES
ALL TYPES OF MACHINES FOR APPLYING STAPLES

or heat-treating operations necessary. Made in $\frac{5}{16}$ and $\frac{1}{4}$-in. diameter rods in 14-in. lengths. Fansteel Metallurgical Corp., North Chicago, Ill.

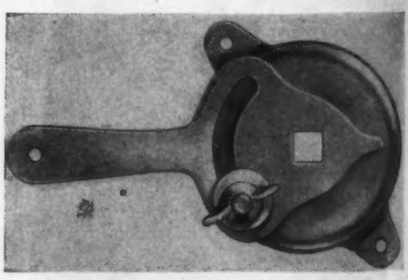
Circuit Tester

Self-contained lightweight portable tester for wiring is announced. Unit is designed to test insulation between wires or from wires to ground, and check the continuity of circuits with audible positive answers at the point where test is made. It is also

claimed to determine visually the polarity of wires. Test current of 500 volts d.c. is provided by hand-cranked generator that develops uniform voltage regardless of cranking speed. Connecticut Telephone & Electric Div. of Great American Industries, Inc., Meriden, Conn.

Damper Quadrant

Damper quadrant, in a pattern for light industry, comes in $\frac{1}{2}$- and $\frac{3}{4}$-in. sizes. Device is plated with rust-resisting cadmium. Features claimed are—ease of installation,



dependability of operation, and ruggedness of construction. Western Air Devices, Inc., 1349 East Vernon Ave., Los Angeles, Calif.

Face Shield

Type V-1 face shield is claimed to offer maximum comfort and protection for face and forehead in light-duty operations, such as spot welding, light grinding, and woodworking. Fits over correction spectacles and extends well back along the sides of the face. Light in weight, the Protecto-Shield has adjustable headband; front

And here's how you make real savings when you use Master Gearhead Motors. Both the motor and gear reduction are built as an integral construction, so you have only one unit to order and handle. You reduce to one third or one quarter your own time for selecting the right equipment, and the time and expense in your purchasing, receiving, and invoicing departments. You save greatly in handling and mounting time. Today time is more than money . . . it's manpower!

But one of the most important savings is usually overlooked. When you buy a gearhead motor, of say 2 horsepower size, both the motor and gear reduction are designed for 2 horsepower load. However, when other types of speed reduction equipment are used, too often you must purchase oversize speed reducing parts that will transmit possibly as high as 5 horsepower, because intermediate sizes are not made.

Yes a penny saved is better than a penny earned . . . it's bonus money. And speaking of bonuses, you get a real one in the wide flexibility of gearhead motors made by Master. Motors in any size from 100 down to 1/10 horsepower in all cycles, phases, and frequencies . . . in open, splash-proof, fan-cooled, and explosion proof types . . . with Speedrangers and Unibrakes . . . for every type mounting . . . and over a gear reduction range up to 432 to 1. Any combination of these can be built easily into a compact power package that will add greatly to the economy, appearance, convenience, and safety of your motor driven equipment.

Investigate what a really remarkable job Master gearhead motors can do for you both in your plant and on your products.

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

a penny saved is a penny earned

10 HP 37 RPM explosion-proof gearhead motor on magnetic separator for removing tramp iron from coal.

WRONG WAY
RIGHT WAY
DETECTO ENDS GUESSWORK IN WEIGHING
Converts ordinary scales into Precision Equipment
DETECTO-GRAM UNIVERSAL HEAD No. 1800

Eliminate overweight and underweight in your weighing operations. Convert one beam scale—or a battery of them—in a few minutes—to accurate, time saving, money saving, weighing equipment. End time losses waiting for a beam to come to rest at *about* correct weight. This head magnifies the balance 9½ times—shows up the tiniest fraction of weight discrepancy. The indicator stops instantly at correct weight.

Try *one* Detecto-Gram Head. Let a Detecto Scale engineer show you *how* much it does to speed work, save money and manpower and end "just-about-right" weighing.

Send for Complete Catalog # 25

DETECTO · SCALES · INC.

MAKERS OF FINE SCALES SINCE 1900

ONE MAIN STREET · BROOKLYN 1, N. Y.

SCALE ENGINEERS IN ALL PRINCIPAL CITIES

cushioning with replaceable leather sweatband; back cushioning with pliable plastic tube; lightweight brow guard; and combination friction swivel and guard. Shield is transparent Lumarith, a product of Celanese Plastics Corp. Willson Products, Inc., Reading, Pa.

Printer-Developer

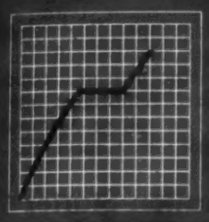
Simple, economical, and efficient printing and developing facilities for black and white prints in medium quantities are said to be provided by Model 41 that combines individual printing and developing units in a steel cabinet. Unit has printing speed

range up to 6 feet per minute, printing either roll stock or cut sheets, with printing width of 46 inches. Light source is 2000-watt glass mercury vapor lamp in a 6-in. diameter cylinder, supplying uniform distribution of light. Unit can be moved to, and operated in, any desired location. No plumbing connections are necessary. Charles Bruning Co., Inc., 4754 Montrose Ave., Chicago 41.

Vacuum Indicator

Tru-Vac Model 18 is a vacuum indicator for products requiring continuous or occasional readings during processing. Operates directly from 110- to 120-volt a.c. lines. Gage is claimed to be scaled to read pressures of a vacuum system from 0.25 to 250 microns, and to be accurate to plus or minus 2 percent throughout the scale,

PROVEN RELIABILITY
Their durability and stamina has been proven with millions of hours of service all over the world.



INCREASE PRODUCTION
Get the right speed for each operation and increase production as much as 40%.

MASTER SPEEDRANGERS

Variable speed operation offers tremendous advantages on many applications. The Master Speedranger provides this infinitely variable speed in a compact, all-metal, mechanical variable speed unit of proven reliability.

ALL-METAL The all-metal construction of the Speedranger insures much longer trouble-free service than units in which less durable materials are used.

COMPACT DESIGN The integral construction of the Speedranger makes it very easy to use . . . only one unit to mount . . . saves space, saves time, saves money.

EXTREME FLEXIBILITY Speedrangers can be supplied for single phase, polyphase, or direct current operation. They can be furnished also with integrally built gear reduction units and electric brakes . . . in enclosed, splash proof, fan cooled or explosion proof construction and for a wide variety of mounting arrangements. No other variable speed unit on the market has such flexibility and compactness.

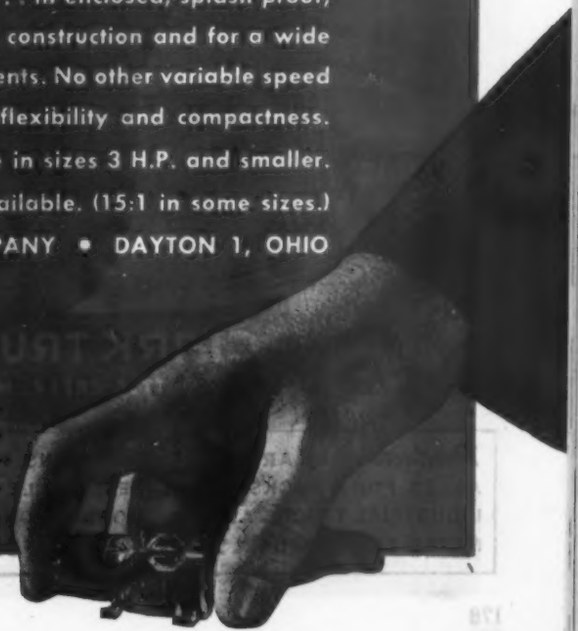
HORSEPOWER Now available in sizes 3 H.P. and smaller.

SPEED RANGES Up to 9:1 available. (15:1 in some sizes.)

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

UNDIVIDED RESPONSIBILITY
Complete Speedranger is designed and built by one manufacturer in one plant.

INFINITELY VARIABLE SPEED
Infinite variations in speed may be secured when unit is at rest or in motion.

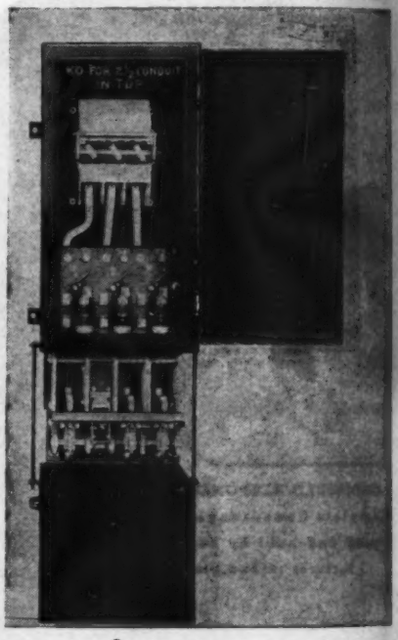


UNSKILLED LABOR ADDS NOTHING TO A PRODUCT EXCEPT COST
CLARK
CLARK Gas Powered FORK TRUCK
RELEASE THEM TO PRODUCTIVE WORK
CLARKAT 2,000 to 2,600 lb. D.B.P.
CLARKTOR-6 2,100 to 3,000 lb. D.B.P.
CLARK ELECTRIC FORK TRUCK 1,000 to 7,000 lb. capacity
Handled PRODUCT of CLARK EQUIPMENT COMPANY
CLARK TRUCTRACTOR
BATTLE CREEK, MICHIGAN, U.S.A.
Products of CLARK • TRANSMISSIONS • ELECTRIC STEEL CASTINGS
AXLES FOR TRUCKS AND BUSES • AXLE HOUSINGS • BLIND RIVETS
INDUSTRIAL TRUCKS AND TRACTORS • HIGH-SPEED DRILLS AND REAMERS
METAL SPOKE WHEELS • GEARS AND FORGINGS • RAILWAY TRUCKS

with constant voltage input. Engineered on the Pitani principle, unit is unaffected by changes in barometric pressure, according to the manufacturer. Adjustment may be made to provide line voltage fluctuations. Continental Electric Co., Geneva, Ill.

Combination Starter

Type LZS-HR combination starter, for use in dusty or corrosive atmospheres, is claimed to provide short circuit protection.

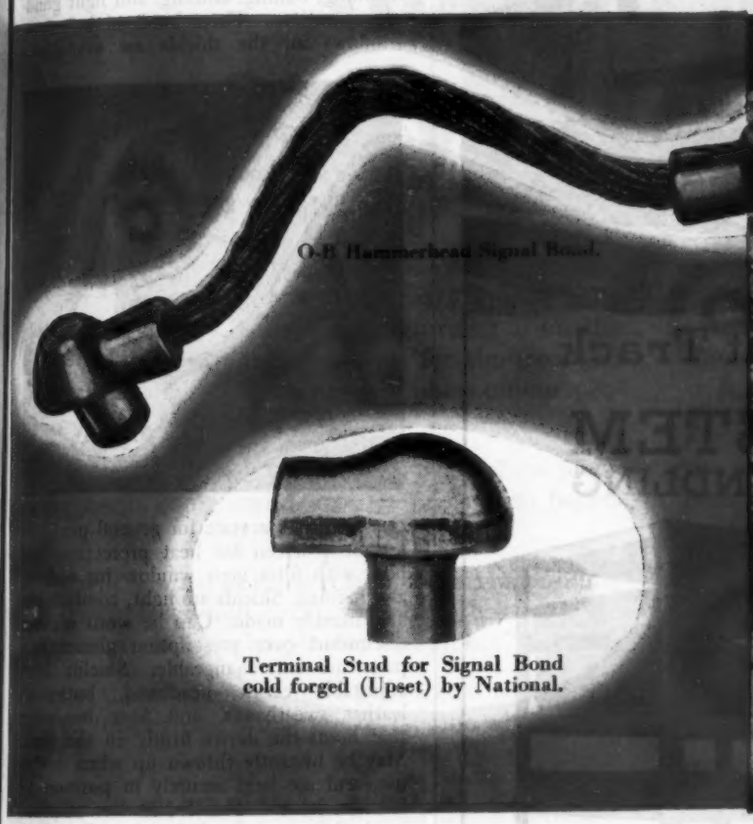


Starter has 3-pole, heavy-duty, oil-immersed contactor, adjustable magnetic overload relays in each line of 3-phase circuit, and disconnect switch with externally operated handle. Starter is rated at 50 hp., 220 volts, and 100 hp. at 440-550 volts. Electric Controller & Mfg. Co., Cleveland.

Pipe Joint Compound

Pipetite-Stik is a pipe joint compound in easy-to-use stick form. Three or four strokes of stick across pipe threads spread and fill threads when turned. Advantages claimed for compound are that it is unaffected by air, water, steam, acid, gas, or brine; lubricates and seals pipe joint threads, nuts, bolts, gaskets, turnbuckles; prevents rusting; and that joints are easily taken apart months, and years, after applying. Also that it withstands vibration, temperature changes, deflection, pressure; increases thread life; contracts or expands

Can You Give Us a Tougher UPSET Job Than This?



O-B Hammerhead Signal Bond.

Terminal Stud for Signal Bond cold forged (Upset) by National.

Hammer Man Driving Bond in Rail for Lifetime Service.

Here's a piece of metal that really takes a beating. It's the terminal stud for Ohio Brass Company's Hammerhead Signal Bond. It must withstand first a severe assembly operation in the plant, then a lusty blow on the head when it's driven into the rail, and finally, the constant vibration throughout the lifetime of the rail as the trains thunder over it.

When production needs for this stud could not be met by hot forging, Ohio Brass put it up to National Screw. It was a very difficult part to upset, particularly with the necessity of procuring perfect grain flow and tempering to prevent difficulties in final assembly and reforming. We worked out a method of upsetting from round wire, solving the problem of securing volume while at the same time reducing the cost.

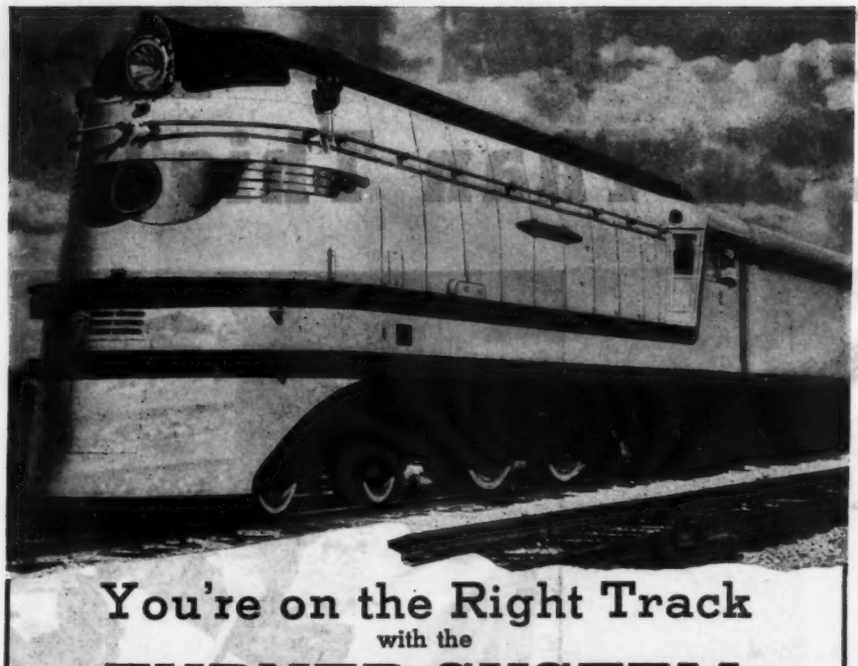
Few upsetting jobs are as tough as this one, but we cite it to show you what unusual things can be done where unusual experience, ingenuity and facilities are at your service.

Have you seen our "Savings" booklet? If not, please write for a copy.

Send for a copy of the "Savings" booklet—brief diagrammatic stories of time and money saved by "National" methods.

National
HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.



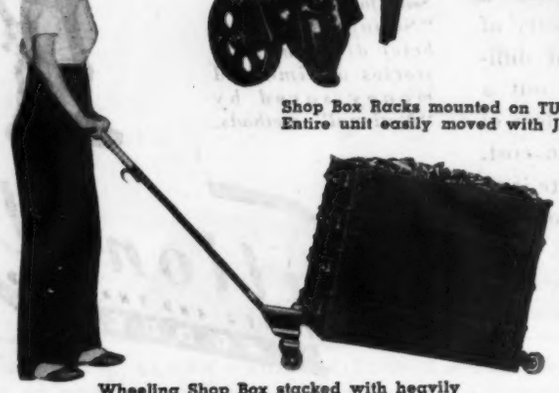
You're on the Right Track
with the
TURNER SYSTEM
OF MATERIALS HANDLING

There is no other one "System" of Materials Handling which is so uniformly standardized, so perfectly coordinated as the "TURNER SYSTEM." It is based on the principle of the perfect square and provides for expansion in almost every direction. Resulting savings in time, labor and space are exceptional.

60 Days Free Trial

We will ship without cost or obligation (except transportation charges) to any responsible manufacturer, a reasonable quantity of Turner units for 60 days free trial.

Shop Box Racks mounted on TURNER Transport. Entire unit easily moved with Jimmy.



Wheeling Shop Box stacked with heavily loaded boxes, easily transported.

Write for Free Book

If you will write for it on your letterhead we will be glad to send you a copy of a new book on the TURNER SYSTEM OF MATERIALS HANDLING which describes the complete plan and shows practical units available.

FACTORY SERVICE COMPANY
4605 N. TWENTY-FIRST STREET MILWAUKEE 9, WISCONSIN

with the pipe, and contains no lead or other injurious ingredients. Lake Chemical Co., 607 North Western Ave., Chicago 12.

Face Shields

Models AO F-100, F-200, F-300, and F-400 face shields are said to provide light-duty protection on metal sawing, acid handling, buffing, sanding, and light grinding operations. Three kinds of button-on windows for the shields are available—

clear cellulose acetate for general purposes; 24 mesh screen for heat protection; and fiber with filter glass window for welding and scarfing. Shields are light, comfortable, and sturdily made. Can be worn without discomfort over prescription glasses. All parts are interchangeable. Shields have adjustable elastic headband, button-on leather sweatbands, and fiber headpiece that holds the device firmly on the head. May be instantly thrown up when not in use, and are held securely in position by friction joints. The F-200 has standard spark deflector; the F-300 has fiber back headband; and the F-400 has, in addition, a full spark or head deflector. American Optical Co., Southbridge, Mass.

Packing

Packing, known as Palmetto Square Flax Packing, is made by a process said to keep it soft and pliable for long periods. Each strand of the flax roving is thoroughly lubricated before the strands are processed into packing. Available in two types—the regular tallow-impregnated packing, and a graphite-coated type, sometimes referred to a waterproof hydraulic flax. Packing is plaited in square form, and is made in a wide range of sizes. Greene, Tweed & Co., Bronx Blvd. at 238th St., New York 66.

Cutting Tool

Melting a steel alloy in indirect arc rocking electric furnace, superheating to well above 3000 deg. F. and casting in molds of the approximate tool size is method used in producing Powersteel tool bits for specific types of work. Process is claimed to give the metal a preferred grain and carbide particle size at the time of casting. Results in a tool said to retain its cutting ability on many types of work for a long time and that can be resharpened and used as long as tool can be held in holder. Nine

★ ★ ★ ★ ★

How to Make Sixty Million Jobs

Here's ONE way . . . . Come peace and America will have a *big* promise to keep. Sixty million jobs! Jobs for the men and women returning from the fighting fronts . . . and *new* jobs for the men and women who have worked the machines on our production front.

Countless communities of America will feel the pinch as cut-backs come and peacetime production begins to get going.

What will happen in those communities surrounding the plants, large and small, that have been making component parts for major war equipment?

Some of them, of course, have plants that will re-convert to former peacetime products. But what of the others?

Decentralization through Sub-Contracting

The advantages of sub-contracting have been spotlighted by the war. It was the widespread use of sub-contracting that enabled America to produce as much and as quickly.

In the reconversion period, sub-contracting can perform like miracles in speed and quantity.

More important . . . it can help provide the answer to the "sixty million job" question. Decentralization of peacetime production can keep America's workers where they are (for many an American family has taken root in a new community.)

America Re-Discovers an OLD Technique

For most of America's industrial plants "working for the other fellow" was a new experience. They had been making only their own products. Sub-contracting for someone else was foreign to their experience. But the early epidemic of high-rejects, delivery failures and such, have by and large given way to better integration. Today industry is functioning *together*.

For Lewyt it was an old experience. We had been at it for over fifty years, making things "for the other fellow". It was logical that our rejects would be low, our integration smoother right at the start.

Yes, we feel that the principle of sub-contracting has been re-affirmed by the war—and that its carry-over into peacetime production will help to provide those sixty million jobs . . . *sooner*.

★ ★ ★

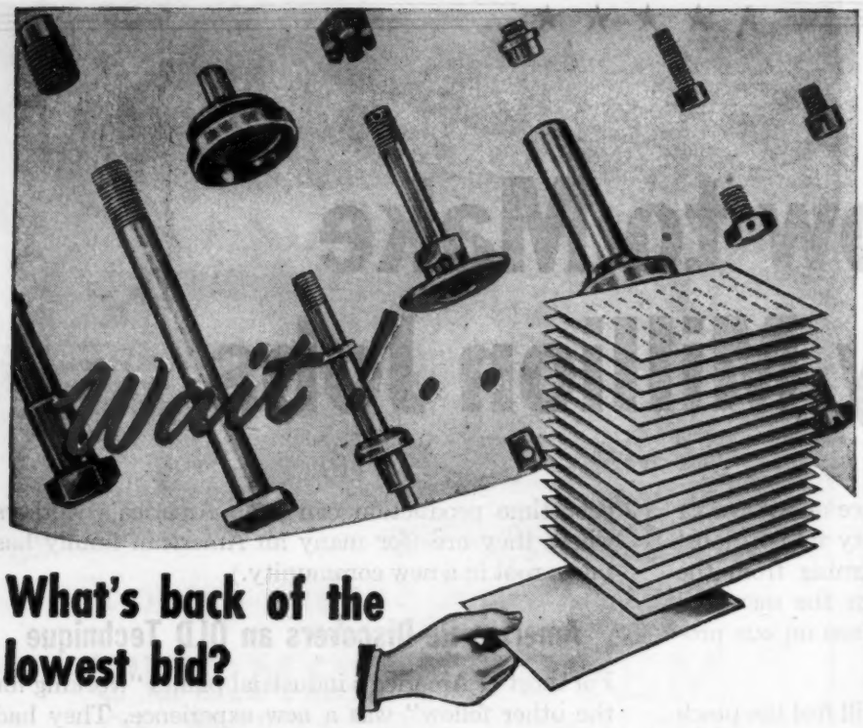
Write on your business stationery for 48-page book, "Let Lewyt Do It"—the story of the Lewyt organization in pictures. Lewyt Corporation, 60 Broadway, Brooklyn 11, N. Y.

ARMY E NAVY

Lewyt

A CONTRACT MANUFACTURER—EXPERTLY STAFFED TO PRODUCE COMPLETE ELECTRONIC AND MECHANICAL ASSEMBLIES, COMPONENT PARTS AND SUB-ASSEMBLIES, TO THE MOST EXACTING REQUIREMENTS

CONTINUE BUYING WAR BONDS



What's back of the lowest bid?

It's easier to ask — *and answer* — this question *before* putting out for bids. Because once the bids are in you may find your choice limited.

You know how difficult it is to write specifications that cover *every* possible contingency. For instance, it may turn out that you could use . . .

1 *Engineering Service* to work out functional design and material in terms of greater mass production . . .

2 *Production Facilities* to meet unforeseen requirements covering strength . . . accuracy . . . finish . . . while keeping delivery and cost in line with your needs.

3 *Manufacturing Stability*—the sound reputation of a supplier that justifies your choice of source for vital parts.

P-3

M³ MEN MATERIALS MACHINES

facilities insure

your ultimate satisfaction with your precision parts. And the bid may not be out of line! This bulletin is published in Sweet's File 4m10 for Product Designers. If you prefer that we send you a copy, please request it on your letterhead.

THE CORBIN SCREW CORPORATION

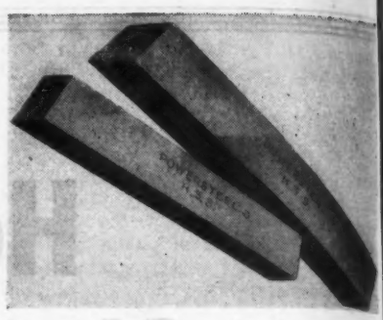
The American Hardware Corporation, Successor

NEW BRITAIN CONNECTICUT

CORBIN

See Sweet's Product Design Catalog, outline of Corbin Products and Facilities

Precision Parts



standard sizes of square bits and five sizes of rectagular bits. Crobalt, Inc., 1366 North Main St., Ann Arbor, Mich.

Convertible Arm Saw

Multiplex-30A radial arm saw is claimed to cut any miter, right or left, up to 90 degrees. Arm along which the saw travels pivots right or left, and arm mounting also moves backward and forward in the

rigid overarm, approximating movement of the human arm, and permitting placing the saw in many positions. Saw is suitable for cutting 1- and 2-in lumber. Light enough to be transported easily from job to job. Machine Tool Div., Red Star Products, 3455 Vega Ave., Cleveland 13.

Pressure Blowers

Centrifugal blower unit, known as type CB, has capacity range from 200 to 5000 c.f.m., and pressure range from ¼ to 2 p.s.i., according to manufacturer. Type CC centrifugal compressor unit is said to range in capacity from 4000 to 75,000 c.f.m., at pressures up to 4 p.s.i. Blowers are

The Boss Says

"NOW I CAN RELAX"

With GARLOCK Packings, Gaskets and KLOZURE Oil Seals installed throughout the plant, the boss can relax. Frequent shut-downs for repacking, etc., are avoided . . . production zooms along without interruption . . . orders are filled . . . and everybody's happy. Standardize on GARLOCK for dependability and long service.

GARLOCK 117 globe and angle valve stem packing is equally effective against high pressure steam, hot or cold water, or oil. Furnished either braided or twisted in all sizes from $\frac{1}{16}$" to $\frac{3}{4}$".

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Garlock

Circo Chief
DEGREASER
Parts cleaning is no longer a problem, a dirty job, a back-breaking operation or a man power wastage—not if you use the new, modern streamlined "Circo Chief" degreaser. Regardless of how greasy, grimy, or dirty parts may be, the "Circo Chief" will vapor clean and dry them in three or four minutes and do all the cleaning automatically. It's designed, engineered and built to handle all parts cleaning, fast, thorough and economical and it's the one way to put parts cleaning on a paying basis. • The "Circo Chief" houses four different cleaning methods—hot vapor cleaning (automatic), spraying (automatic), dipping and soaking. • With the "Circo Chief" all the operator has to do in vapor cleaning is turn on the switch, feed it parts, the unit does all the cleaning automatically. The hot solvent vapor in the tank encompasses each and every part, thoroughly cleaning, rinsing and drying them all in a matter of minutes which means greater production with less effort, less cost, and no man power wastage. • Anyone can operate the "Circo Chief" as it heats automatically, starts and stops automatically, feeds itself solvent automatically, and should the solvent supply become exhausted, it will automatically shut itself off. Many of the large repair shops, industrial plants, etc., find it economically sound and practical to use a fleet of Circo degreasers, each stationed in a strategic point in the plant and handling all the parts cleaning work in that particular area. • To spray or flush parts, trip foot pedal, pump goes into immediate action and a constant pressure stream of solvent sprays, rinses and cleans parts. Wire basket is equipped with unique handles enabling operator to hook them over sides of tank for hot vapor cleaning, spraying, dipping or soaking. • Solvent is non-inflammable and it will clean all types of metal at the same time without any harmful results. • Regardless of what your past experience has been in parts cleaning, the "Circo Chief" will show you a new kind of performance, cleaner parts in less time, at less cost and requiring no help other than someone to feed it work.
Send in for more detailed information.
CIRCO PRODUCTS CO.
2835 CHESTER AVE. CLEVELAND 14, OHIO
NOT 1
NOT 2
NOT 3
BUT 4
CLEANING METHODS
IN ONE UNIT
SPRAYING
VAPOR CLEANING
SOAKING
DIPPING

suitable for handling air for oil or gas furnaces; high pressure installations in glass, steel, and chemical plants; as gas exhausters and line boosters; for scale and water blowoff problems, and other uses. Buffalo Forge Co., Buffalo, N. Y.

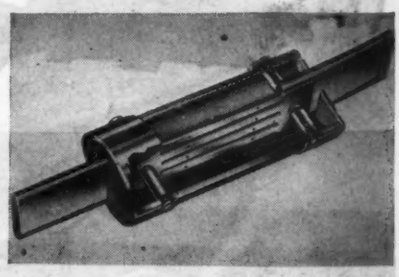
Safety Cap

Made of dark blue cotton netting, safety cap for women protects the hair-do and at the same time gives the wearer a jaunty

look. Cool for summer wear, because the mesh work allows free passage of air to the scalp. Visors are said to be fire resistant. Cap is washable. Brewster Hat Co., Inc., 411 Fifth Ave., New York.

Cartridge Fuse

Non-renewable cartridge fuse incorporates a grid link that is claimed to replace four single links, with only two solder connections to the blades necessary instead of eight, to reduce possibility of loose con-



tacts, and to increase heat distribution. By employing a metal crossbar to position the link and blade, they can be anchored into the complete assembly by a stud riveted through the ferrule and casing into the crossbar. Royal Electric Co., Inc., Pawtucket, R. I.

Flexible Shaft Angle Drills

Line of flexible shaft angle drills includes both 18- and 30-in. flexible shafts coupled to 45-, 90- or 360-deg. angle drills. Flexible shafts can be supplied for other angle drills, or with threaded spindle for direct use without angle drill. Shaft has piano wire stress-relieved core encased in oil-resistant rubber, and is fitted with oil-less type bronze bearings. Drill heads are said to be precision made to close standards,

Bunting Cast Bronze Bearings have endless variety —stock or special, simple, complicated, standard or precision, usual, unusual—Bunting alloys or your own. Look to Bunting for your bearing specifications of tomorrow. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Warehouses in principal cities.

Bunting

BRONZE BEARINGS ☆ BUSHINGS ☆ PRECISION BRONZE BARS

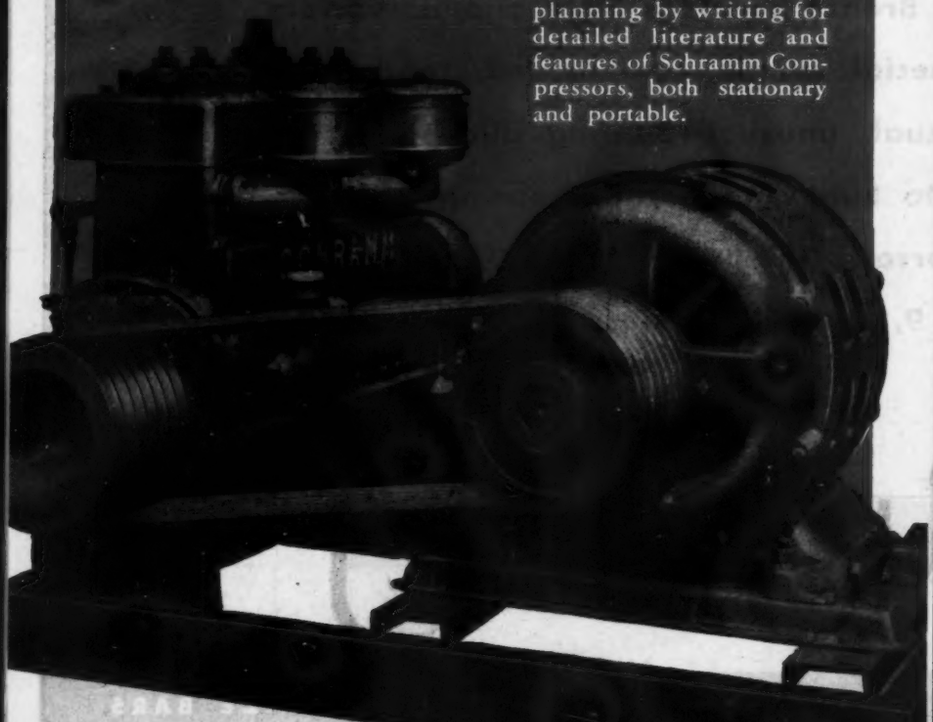
4 REASONS
POWER PLANTS SPECIFY
SCHRAMM
AIR COMPRESSORS

1. 100 PER CENT WATERCOOLED
2. COMPACT—LIGHTWEIGHT
3. MECHANICAL INTAKE VALVE
4. FORCED FEED LUBRICATION

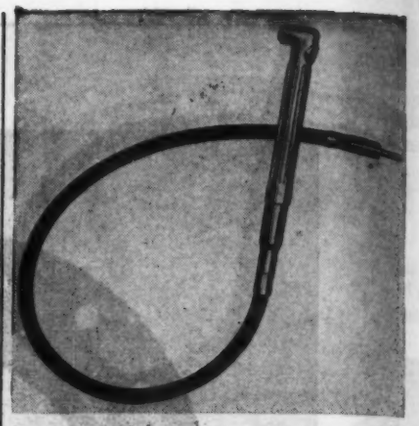
There are many compressed air jobs to be done by Power Plants, and into this versatile picture fits the Schramm Air Compressor. Its features enable compressed air jobs to be done quickly—easily—economically!

Illustrated here is a stationary unit, one of many types of Schramm Compressors. They are designed for heavy duty, continuous service, with minimum attention.

Schramms are built in sizes ranging from 20 to 600 cu. ft. displacement in every type of mounting and assembly. Start your compressor planning by writing for detailed literature and features of Schramm Compressors, both stationary and portable.



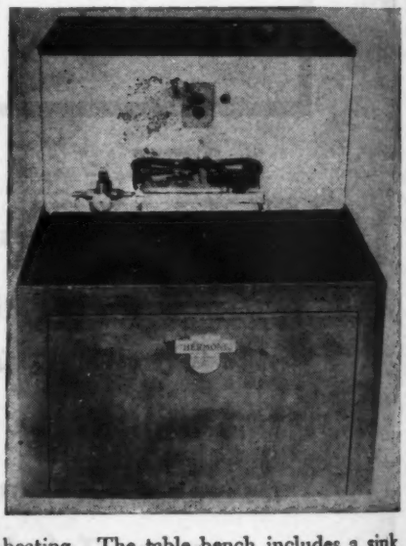
SCHRAMM INC. THE COMPRESSOR PEOPLE WEST CHESTER PENNSYLVANIA



with heavy-duty bevel gears and non-friction ball and needle bearings. Zephyr Manufacturing Co., Inglewood, Calif.

Induction Heating Work Table

Single-position, general-purpose work table is designed for use with Thermonic induction generators. Equipped with a standard Thermonic output transformer, so mounted as to effect interchangeability from one type of transformer to another, table can be used, according to manufacturer, for any application of induction



heating. The table bench includes a sink with removable transite cover, for use in spray quenching operations. Water piping provisions for spray quenching are incorporated in the table, together with a solenoid-operated valve and a quench flow regulator for controlling the timing and volume of the quench. Start and stop control buttons are mounted on the front of the table, together with pilot light indicators. Induction Heating Corp., 389 Lafayette St., New York 3.

Latch for Safety Hooks

Latch for safety hooks is said to give 80 percent of the full throat opening, and to decrease the possibility of overloading and overcrowding in general hoisting and materials handling. The wide throat opening results from the way latch assembly, when

WHY DIDN'T I WAKE UP?

I CAN HAVE FULL PROTECTION

for my motors and motor-circuit equipment, and the fullest flexibility in their performance, by using THERM-A-TRIPS. THERM-A-TRIPS allow motors to start and run on normal overloads. They safeguard at all times against excessive overloads and short circuits. They are positive in their operation. They occupy a small space. They require no attention. They are inexpensive. And with THERM-A-TRIPS, no other overload protection is needed.

THE CHASE-SHAWMUT COMPANY
NEWBURYPORT, MASSACHUSETTS

FUSE MAKERS SINCE 1893

REX-TUBE

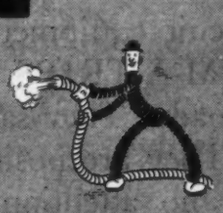
Top choice for tough jobs!

● Put REX-TUBE type RT-15 on your tough, hard-to-handle connection problems. Then watch what happens when this rugged, high-quality flexible metal hose takes charge of the heavy-duty assignments! You can forget all about frequent replacements—costly delays. For RT-15 is famous for its ability to take punishment; to keep right on outperforming and outlasting many other types of hose under the roughest usage you can give it.

There are ample reasons why production men choose REX-TUBE type RT-15 when it comes to taking hard knocks. Illustrated below are just a few of RT-15's many outstanding features. Write us today and ask for Booklet E-144.

REX-TUBE (RT-15)—is strong and well-constructed to take years of wear and tear. Made from heavy strip, steel or bronze. Interlocked design, with inner packing of high-grade asbestos.

REX-TUBE (RT-15)—is widely used for handling steam at low and moderate pressures, for unloading and loading tankers and barges, steaming out tank cars, and other "hot" process jobs.



REX-TUBE—is part of the big, complete C.M.H. family of Flexible Metal Hose. RT-15 is only one type in the REX-TUBE line. There are other REX-TUBE types, in various sizes, with soldered or packed-on couplings, to meet practically any industrial requirement.

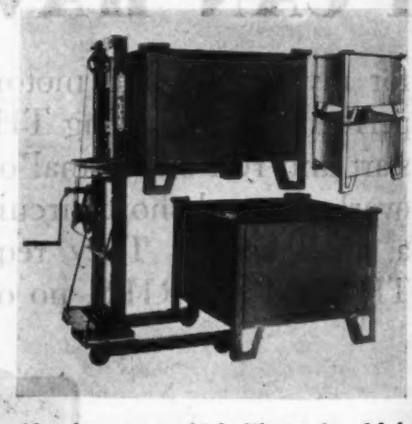
Flexible Metal Hose for Every Industrial Use

CMH CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

open, straddles neck of the hook. The load to be hoisted is easily slipped into the hook but cannot be removed until operator's fingers release the latch, preventing risk of dropping loads and endangering bystanders. If hook is overcrowded, the latch will not snap into place. If the hook spreads because of excess loading, latch pops up as a warning signal. The Thomas Laughlin Co., Portland, Me.

Steel Storage Bin

All-steel bin for handling small parts is announced. Corner plates allow for convenient stacking and storage. Four-way entrance permits pick-up from any side. May be handled with hand or power lift truck, or fork truck and tiered with port-



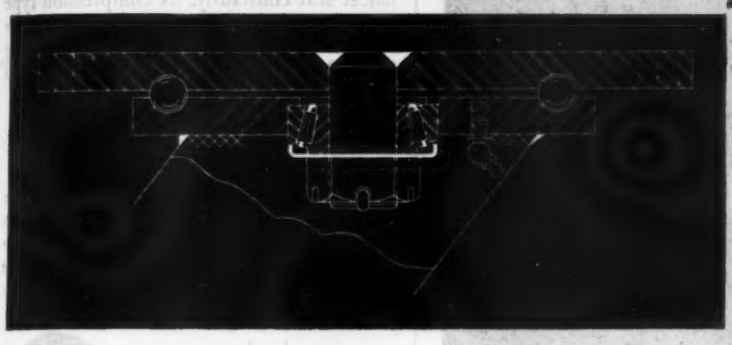
able elevators or high lift truck. Made of heavy steel plate with corner reinforcements and legs of angle iron. Palmer-Shile Co., 7110 W. Jefferson Ave., Detroit 17.

Fluroescent Unit

Industrial fluorescent unit for illuminating areas where long, continuous lines are to be used, as over benches where precision work is done, can also be used as an exposed troffer in certain installations. Available with or without louvers. Louvers are of all-steel construction, and provide 25-deg. crosswise, and 15-deg. lengthwise shielding, are supported at 4 points, and may be swung down for maintenance. Units can be hung individually or in

BUILT FOR THE BUMPS

A new Bassick caster for trailers extra-sturdy where it takes abuse



This is a caster especially designed for the abuse of power-pulled trailer truck service. At every vital point, there is extra strength, to give longer, trouble-free life.

Note these strong points. 5/8" diam. balls rolling in machined raceways, on a 6½" diam. ball race, with Timken roller thrust bearing. Heavy gauge steel plate in frame and top plate. Heavy-duty semi-steel or iron core rubber-tread roller-bearing wheels. Alemite pressure lubrication. 3" swivel offset.

These Bassick Trailer Casters are offered in 8", 10" and 12" sizes, with either standard or "Floating-Hub" (shock-absorbing sprung wheel) construction. Swivel or rigid type.

And for *any* caster requirement—small or large—look to Bassick for: 1, The exact type and size to fit your requirements, for Bassick makes the world's most complete line. 2, Special Bassick features that improve handling, reduce maintenance, lengthen life of casters, portable equipment and floors.

For bulletins on any caster type, write now to THE BASSICK COMPANY, Bridgeport 2, Connecticut. Division of Stewart-Warner Corporation. Canadian Division: Stewart-Warner-Alemite Corporation, Ltd., Belleville, Ontario.

You save a lot of labor
And speed production faster
When anything you want to move
Is on a Bassick Caster.

SEE OUR CATALOG IN SWEET'S

Making more kinds of Casters... Making Casters do more

Bassick

name your gaseous HAZARD— here's specific PROTECTION!

M·S·A INDUSTRIAL GAS MASK

Preferred throughout industry, M.S.A. Industrial Gas Masks with the All-Vision Facepiece provide comfortable, dependable protection for the worker against scores of individual gases, or combinations of gas, smokes, vapors and dusts. With the M.S.A. "GM" series of interchangeable, replaceable canisters, it is necessary only to select the type designed to protect against your particular gaseous hazards—the easy wearing comfort and superior design features of these famous Masks are inherent service advantages, evident on every protection assignment.

EACH OF 13 INTERCHANGEABLE M-S-A CANISTERS PROTECTS AGAINST ONE OR A GROUP OF HAZARDOUS GASES. WRITE FOR BULLETIN ED-71

MINE SAFETY APPLIANCES COMPANY
BRADDOCK, THOMAS & MEADE STS., PITTSBURGH 8, PA.
IN CANADA
MINE SAFETY APPLIANCES COMPANY OF CANADA LIMITED
TORONTO, MONTREAL, CALGARY, VANCOUVER, NEW GLASGOW, N. S.

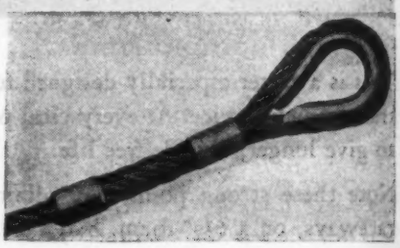
continuous lines by means of chain, conduit, or cable. Can be wired for pull switch. Wired for 110-125 volts a.c., but can be furnished for 220-250 volts. Curtis Lighting, Inc., 6135 West 65th St., Chicago 38.

Faucet Repair Device

No-Krode is patented compression-type replacement unit for repairing leaking faucets. Consists of bronze spring, Buna S washer, and glass ball. Adaptable to standard faucets, and is said to provide lasting leak-proof repair. Installation requires less than 5 minutes. Spring performs two functions—acts as a cage for the glass ball, and its tension presses the washer against faucet seat constantly. A compression-type unit, it is claimed to cause no friction wear on washer, since it never rotates. Superior Valve Manufacturing Co., 1468 West 9th St., Cleveland 13.

Safety Splice

Acco-Loc method for splicing wire rope into slings or various assemblies develops a neat and compact splice that is flexible clear to the terminal, and develops 100 percent of the rope's strength, the maker



says. The safety splice does not distort rope structure, and so maintains equalization of stresses in all strands. Also, applies the load stress in direct line with the pull of the load, and has no seizings to loosen. Can be used with standard fittings—hook, ring, shackle, or thimble—and when the sling or assembly is retired such fittings can be salvaged and re-used. At present the splice can be applied only at the factory. American Chain & Cable Co., Inc., Bridgeport, Conn.

Axial Flow Fans

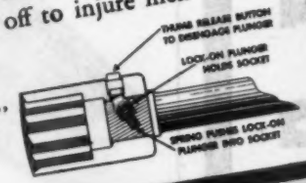
Type "B" axial flow fans, for general ventilating and air conditioning service, are announced. Welded steel wheel is

Mark Purchase Records *Permanently* to Specify Blackhawk Socket Wrenches

These Men Tell You Why!

SAFETY ENGINEER

"I go for Blackhawk's exclusive LOCK-ON. It eliminates danger of sockets falling off to injure men or damage machinery. I insist on LOCK-ON!"



ASSEMBLY SUPERINTENDENT

"Blackhawk Sockets are smooth-broached. We get faster nut-fits. No rounded-off nuts, or slip-offs to mar jobs. Interchangeable Blackhawk Socket Wrenches give just the right combinations for all jobs."

COST DEPARTMENT

"Hot-broached sockets and tougher metals mean longer life—less replacement costs. Blackhawk's range gives us a good selection of wrench set-ups for production work, to help conserve man-hours."

SERVICE ENGINEER

"With Blackhawk Torque Indicators, we get proper tension on nut and bolt assemblies — which means fewer service problems in the field. We recommend Blackhawk Torque Indicators for service work too!"

MAINTENANCE MAN

"No cussing over lost sockets with Blackhawk Socket Wrenches. LOCK-ON clicks 'em on to *stay*—until I press the Thumb-Release button when I want to take 'em off."

ENGINEERING DEPARTMENT

"We've ditched designing and making costly 'special' wrenches...after discovering how many combinations can be *built* from standard Blackhawk sockets, handles, and attachments."

Buy Blackhawk Wrenches from Your Blackhawk Industrial Supply Distributor.

A Product of BLACKHAWK MFG. CO.
[illegible] Milwaukee 1, Wis.

ARMY E NAVY

BLACKHAWK

DARNELL CASTERS

DARNELL CASTERS

• Save Money, Floors, Equipment and Time by using DARNELL Casters and Wheels . . . Always dependable.

FREE Manual FOR THE Asking

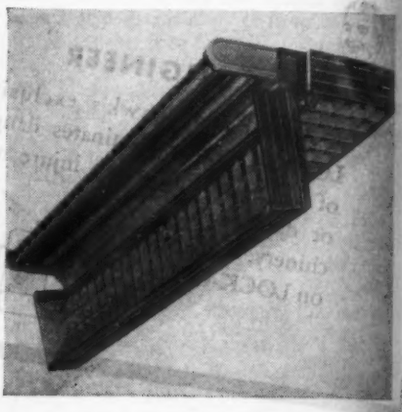
A SAVING AT EVERY TURN

DARNELL CORP. LTD. 60 WALKER ST. NEW YORK 13, N.Y.
LONG BEACH 4, CALIFORNIA 36 N. CLINTON, CHICAGO 6, ILL.

used, with large hub and varying blade pitch, to give uniform air flow over entire blade. Large hub prevents re-entry losses. Housings are heavy-gage welded steel; rigid motor supports permit use of standard motors. Fans are made in belted or direct-connected models, in capacities up to 45,750 c.f.m., and pressures ranging up to 1½-in. static. Belted models are vane-axial only, with stationary directional vanes, direct-connected. Buffalo Forge Co., Buffalo, N. Y.

Steel Lighting Fixture

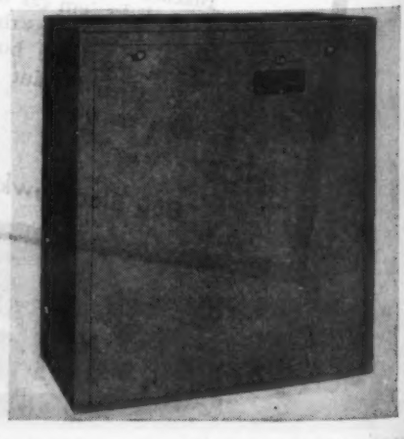
All-steel Louverlite provides a fixture for lighting drafting rooms, offices, and fac-



tories. Each model is made for a specific lighting situation. Reflectors direct a full flood of light downward, permitting a small indirect component to light the ceiling area. Steel hinged eggcrate louvers, made in two sections, give access to the lamps. Starters are handy to reach, and wiring runs along a special steel channel, simplifying maintenance. A. L. Smith Iron Co., Chelsea, Mass.

Cooler for Machine Tools

Hermetically sealed packaged cooling units are said to control the variables caused by coolants and cutting oils, produce uniform temperature condition, and step up production rate and quality. Advantages claimed by manufacturer are—minimum machine adjustment, accurate location and tolerances, cool workpieces, control of oil viscosity and runouts, reduction in water consumption, and long tool life. Compact and self-contained, the system is



INVESTIGATE

"600" ALLOY
IT CONTAINS NO TIN

Preference Order M-43 prohibits the use of more than 2% of tin for many types of products. Wrought or Cast Bronzes needed for bearing or wearing surfaces require 5% or more of tin. "600" ALLOY contains no tin, but fulfills the same services. Its use, therefore . . . for many applications, nullifies any hardship which might result because of this limitation.

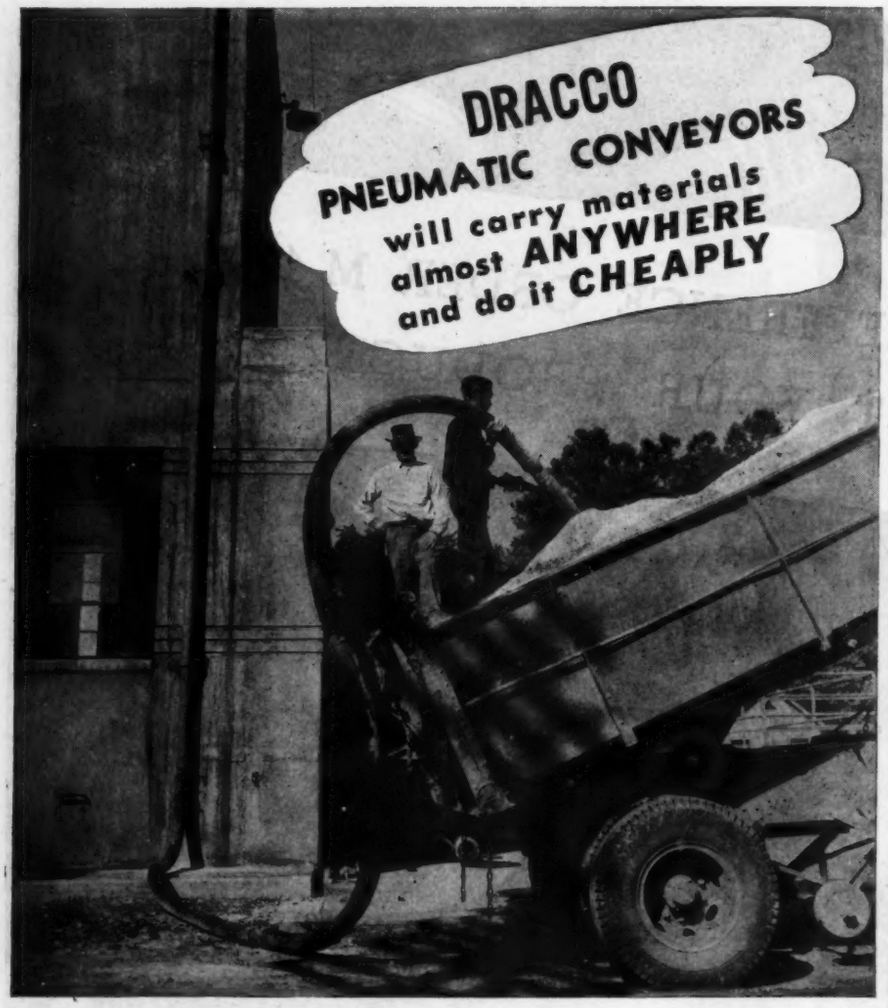
Bearings of "600" ALLOY, Gears, Pinions, Bushings, Spindles, and many other parts, have successfully replaced Phosphor Bronze applications, and at a substantial reduction in cost. "600" ALLOY weighs about 8% less than Phosphor Bronze and carries a lower base price.

In addition to bearing qualities, this alloy has excellent physical properties, corrosion resistance, ability to operate with scant lubrication and withstands abrasives better than most bearing alloys. The high strength of "600" ALLOY is often taken advantage of because it is possible to manufacture in *one piece*, a unit requiring the combined properties of two or more ordinary alloys.

"600" ALLOY is a FORGEABLE Bearing Metal which has a density and homogenity of structure, while Phosphor Bronze has a tendency towards porosity. "600" ALLOY will outwear stainless steels, nitrided steels and bronzes when operating in liquids containing abrasive materials such as grit or sand.

Samples of "600" ALLOY are available for test purposes. Write us if you have a bearing problem. "600" ALLOY may be the very solution.

MUELLER BRASS CO.
PORT HURON, MICHIGAN



FLEXIBILITY is one of the outstanding features of DRACCO Pneumatic Conveyors. They can be installed in old or new plants. The lines are carried over or under railroad tracks or streets—from one building to another and in some cases several hundred feet long. Materials are moved up many stories as indicated in illustration. If you move chemicals, grains or granular materials reduce handling costs to the MINIMUM with DRACCO Pneumatic Conveyors. DRACCO Engineers have over 30 years experience, why not consult them?

For Further Information Write

DRACCO CORPORATION

4091 E. 116th St., Cleveland 5, Ohio *New York Office:* 130 W. 42nd St.

DUST CONTROL EQUIPMENT
PNEUMATIC CONVEYORS • METAL FABRICATION

automatic and simple to operate, and adjustable to suit the individual machine. Airtemp Div. of Chrysler Corp., Dayton.

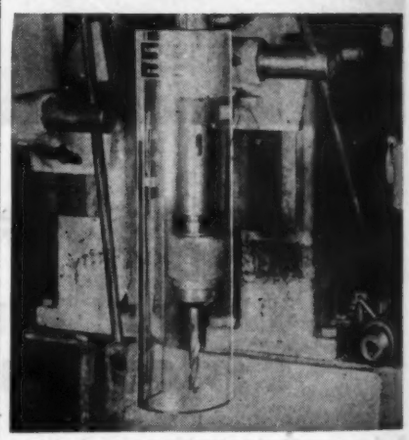
Collapsible Portable Screen

Portable screen unit consists of rustproof, fully collapsible steel frame, with springs to hold screen smooth and flat, supported

on legs that raise screen up to 5 feet above ground. Ranges in size from 7x9 to 11x14 feet. Fold-Pak screen fabric can be folded and is washable. When dismantled, unit fits into carrying case. Radiant Manufacturing Corp., 1140 West Superior St., Chicago 22.

Transparent Safety Guards

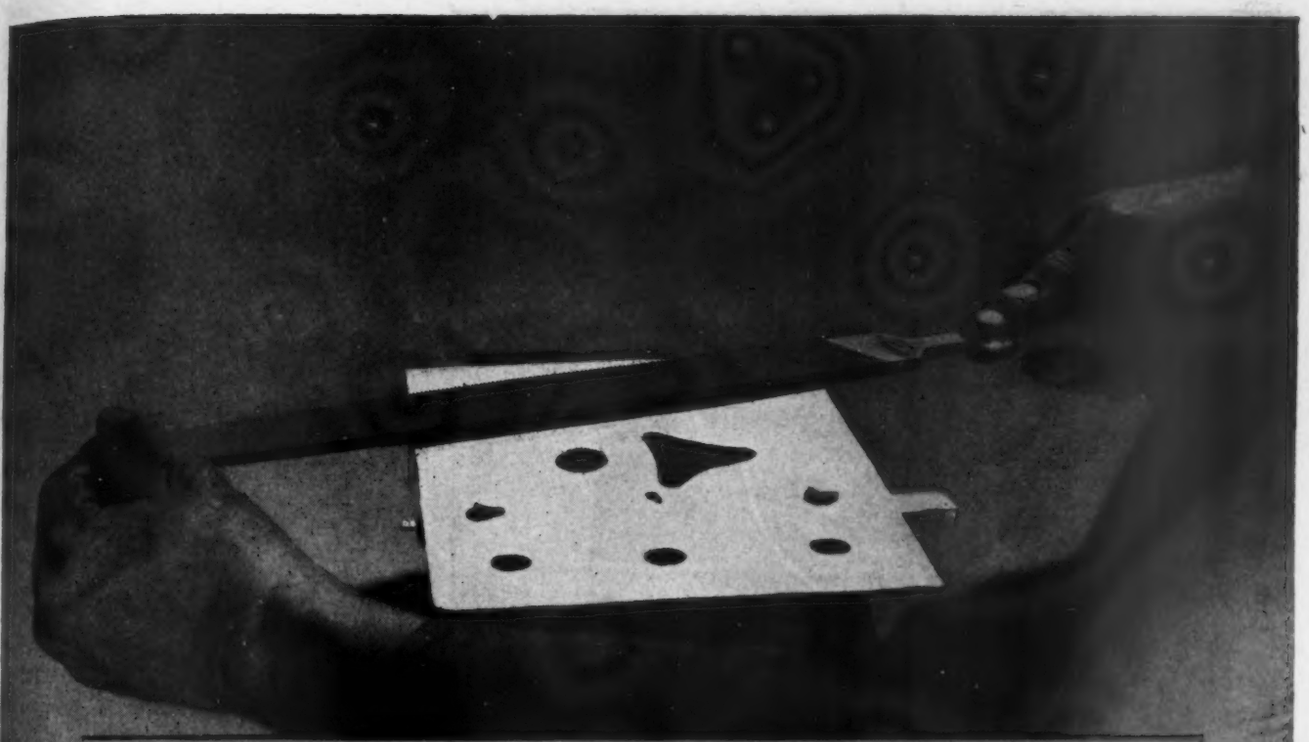
Kleervu safety guards are said to combine worker protection with unobstructed visibility. They are transparent, allowing full view of the machine and work without



hindering operation. Offer protection from sparks, metallic particles, splashing liquids, and similar hazards. Made of heavy-gage plastic, with high resiliency, and can be sawed or drilled easily, as well as molded into different shapes or contours. Wright-Austin Co., 301 West Woodbridge St., Detroit 26.

Automatic Stoker

Streamlined automatic stoker has gray cast iron cover to protect machinery, belts, and moving parts from coal dust and dirt. Features oil-less bearings, self-aligned ball-bearings, water cooling, and proper pump. Unit is said to burn fuel of almost any type, from highest quality coal to lignite,



Smooth-filing Stainless Steel

THE remarkable thing about filing stainless steel is that there is a file that is able to stand up at all against this hard, tough metal.

But Nicholson has done it — with a distinctive file-tooth design. This feature and great care in hardening give Nicholson Files for Stainless Steel special virtues for long-lasting efficiency despite the abrasive action of the hard chromium and nickel content they encounter.

Only light pressure is required to enable Nicholson Files for Stainless Steel to take hold, yet leave a good finish. Available, through your mill-supply house, in the same shapes, sizes and cuts as regular purpose files. Be sure your orders for these files specify "for Stainless Steel."

"FILE FILOSOPHY"—Put this interesting, profusely illustrated 48-page "handbook" on kinds, use and care of files into the hands of your key production, tool-shop and purchasing men. We've a limited supply for your judicious distribution. FREE.

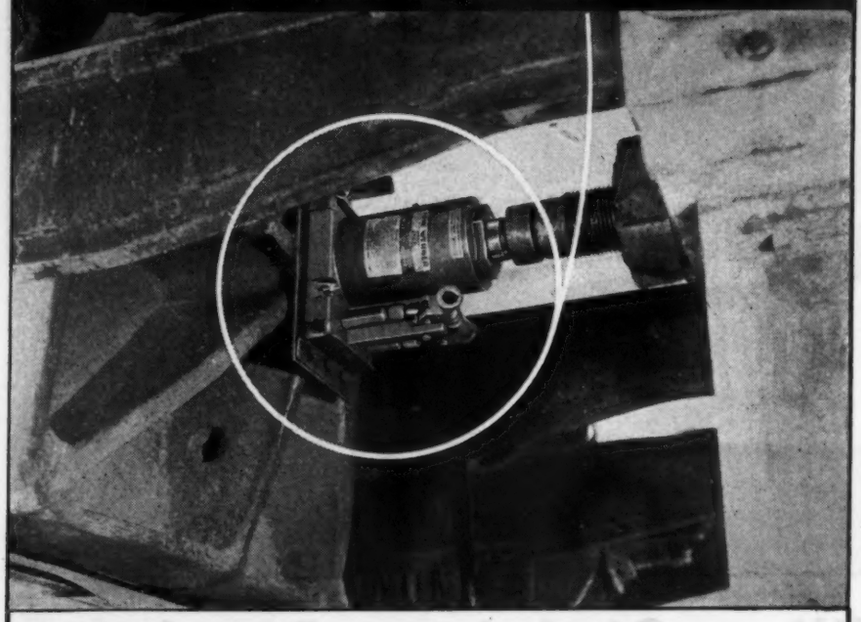
NICHOLSON FILE CO. • 27 ACORN STREET, PROVIDENCE 1, RHODE ISLAND
(In Canada, Port Hope, Ont.)

NICHOLSON FILES
FOR EVERY PURPOSE

NICHOLSON U.S.A.

• Nicholson Special File for Stainless Steel in single (Mill) cut. This and the Flat Finishing (double cut) are most commonly used for smooth-filing. For lathe work, cut is that of the Long Angle Lathe File.

Every day finds new uses for Hein-Werner Hydraulic Jacks



BIG SQUEEZE--

30-ton capacity H-W Hydraulic Jack enables one man to close 36″ filter press in 30 seconds...

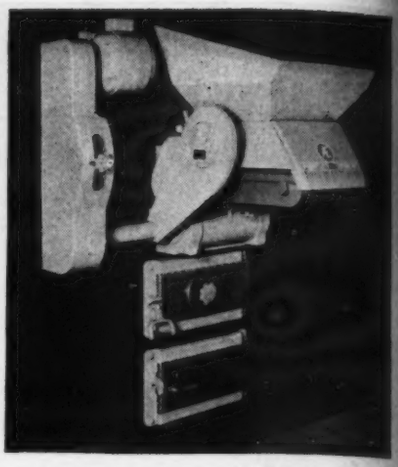
Many tough jobs are made easy —at low cost—through the use of Hein-Werner Hydraulic Jacks.

Applications are almost unlimited . . . For example, note the use illustrated above. Here a H-W Model 30.11A has been attached to a 36″ filter press. Now, the job of closing the press can be done in less than 30 seconds by one man, whereas two men required 10 to 20 minutes with the old method of gear and pinion.

The complete line of H-W Jacks includes models of 3, 5, 8, 12, 20, 30 and 50 tons capacity . . . Great for lifting heavy loads, moving machinery or materials, pressing bushings, gears, pinions, etc . . . Ask your industrial supply distributor, or write us for details.

Dual Operation of Two Speed Pumps is an outstanding and exclusive feature of 30 ton model.

HEIN-WERNER MOTOR PARTS CORP.
WAUKESHA, WISCONSIN



corn cobs, sawdust, or factory refuse. Entirely automatic, the stoker, in multiple units, is capable of delivering 8000 to 200,000 pounds of steam per hour, according to manufacturer. American Engineering Co., Philadelphia.

Oil Absorbing Compound

Oil-Dri-(All-Purpose) is said to absorb oil and grease from oil-covered floors, as well as emulsions and water and soluble oil solutions, leaving floors in their original condition. Suitable for use in industrial plants and other places where slippery floors are a hazard. According to the manufacturer, compound is non-combustible, non-acid, non-abrasive, and harmless to hands, face, clothing, and shoes. Oil-Dri Company of America, 5036 North Ravenswood Ave., Chicago.

Plastic Hammers

Artus Red-Hed plastic hammers are said to eliminate all risk of marring metal surfaces. It is claimed that handles are securely pinned to the head, with no chance

of flying off or becoming loose, that there are no faces to fall out or become loose in head; also that hammers are safe to use where there are chemical or petroleum hazards, because no sparks are created. Industrial Products Suppliers, 2 Broadway, New York 4.

Self-Locking Pins

Standard and self-anchoring vibration-proof pins, that are pressed or driven into standard drilled holes, have four flutes on the surface parallel to the axis whose raised edges provide expanded diameter of a few (specified) thousandths greater than the nominal diameter of the pin. When pin

The bulletins shown are typical of the engineering service Falk renders to industry.

The Phrase FALK ... A GOOD NAME IN INDUSTRY *Possesses Tangible Values For You!*

The individual sale of a product is incidental. The service which that product renders is all-important . . . All-important to the buyer, because the continued satisfactory performance of that product confirms his judgment in purchasing it . . . All-important to the seller, because the satisfaction rendered the buyer enables the manufacturer to make sale after sale.

Falk products have been rendering a satisfactory service to industry for over 50 years. It is this satisfactory service that has enabled The Falk Corporation to continue, and to progress. It has enabled the buyer to depend on Falk claims for its products, and to depend on the performance to be secured from those products.

This is what we imply when we say: "Falk . . . a Good Name in Industry." That phrase includes the Falk philosophy of doing business, its policies, its research, its engineering skills, its production facilities, its service to industry, to its community, and to its employes. All this has given the Falk name a tangible value; and this tangible value has been meticulously maintained.

You who buy Falk products have acclaimed Falk a good name in industry. The fact that you were jointly responsible for this good name automatically provides you with values that would not otherwise be available.

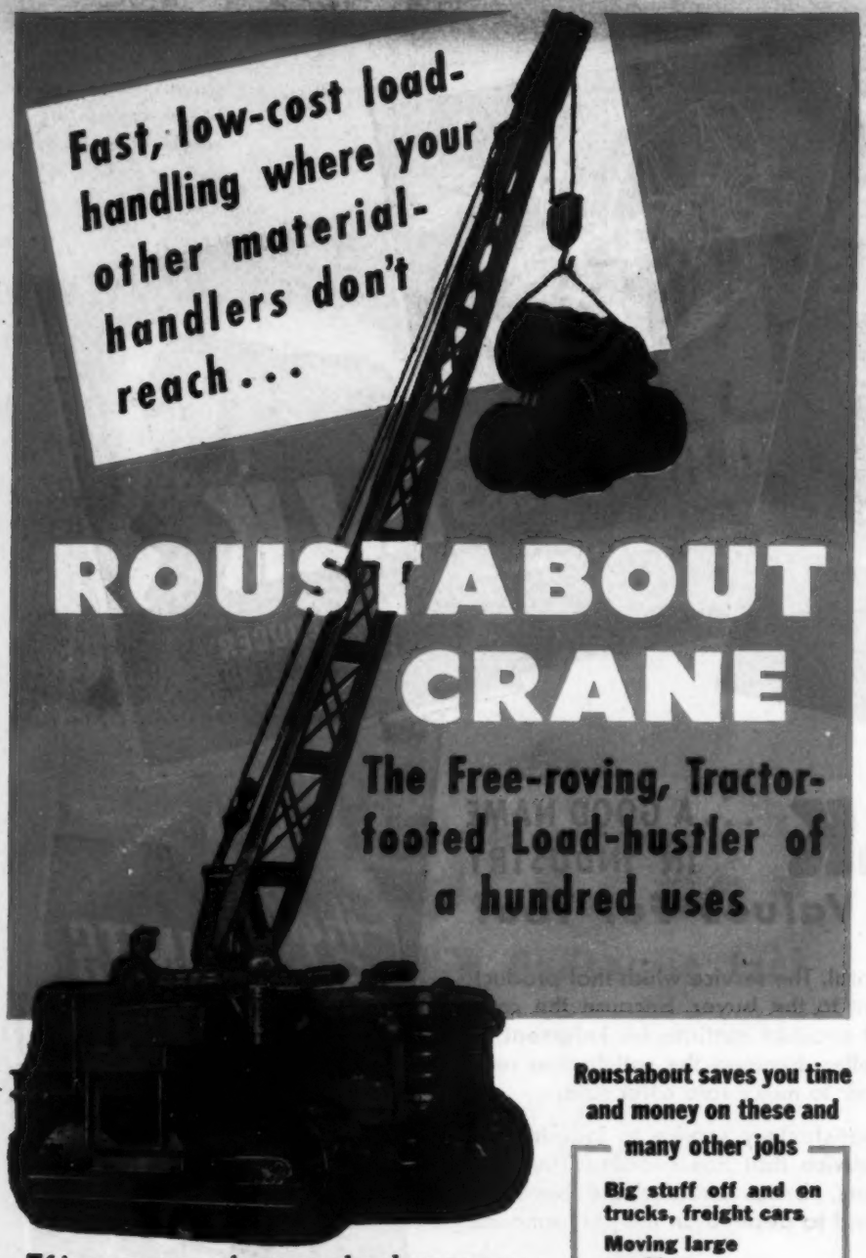
Therefore we say "Falk . . . a Good Name in Industry" possesses concrete value, and carries the assurance that "it always pays to consult Falk."

THE FALK CORPORATION, MILWAUKEE 8 WISCONSIN

IT ALWAYS PAYS TO CONSULT **FALK** . . . A GOOD NAME IN INDUSTRY

For over fifty years
Precision Manufacturers of
Speed Reducers • Motoreducers • Flexible Couplings • Herringbone and Single Helical Gears • Heavy Gear Drives
Marine and Diesel Engine Gear Drives and Clutches • Steel Castings • Contract Welding and Machine Work.

District offices, representatives, or distributors in principal cities.


Fast, low-cost load-handling where your other material-handlers don't reach . . .
ROUSTABOUT CRANE
The Free-roving, Tractor-footed Load-hustler of a hundred uses

If it pays you to have overhead cranes, conveyors or factory trucks, you'll find your versatile Roustabout Crane highly profitable outside their range — for moving, loading, stacking heavy stuff all around your plant. Instant action where needed — no crews taken from other work. Smooth easy operation — picks up a 7½ ton machine or sets down a crate of eggs safely. Built for years of overwork — ball-bearing boom turntable, gears in oil. Hundreds of plants regard their Roustabouts as indispensable. Write for the facts about this fast-action wheel or crawler crane.

Roustabout saves you time and money on these and many other jobs

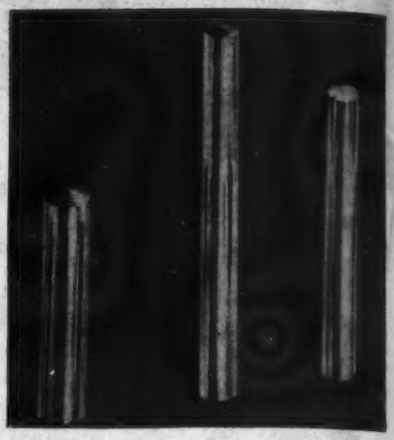
- Big stuff off and on trucks, freight cars
- Moving large machines
- Handling bales, boxes, drums
- Moving big castings, motors, railroad and marine gear
- Loading air transport planes
- Handling tanks, pipe, structural steel
- Installing heavy valves and fittings

ARMY E NAVY

THE HUGHES-KEENAN COMPANY
623 Newman Street, Mansfield, Ohio

ROUSTABOUT CRANE

Roustabout Cranes
By Hughes-Keenan
Load-Handling Specialists Since 1904



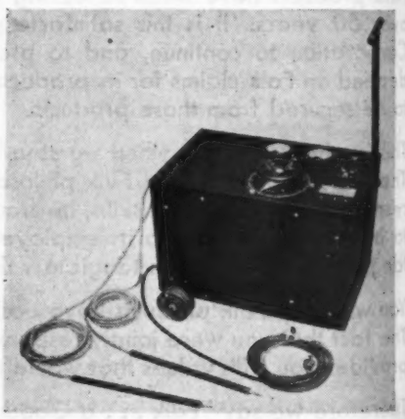
is inserted in a drilled hole, raised edges are compressed inwardly, providing resilient self-locking element that is claimed to hold indefinitely under vibration or shock. Driv-Lok Pin Co., 565 West Washington Blvd., Chicago 6.

Cleanser

Detergent, known as Alconox, is said to leave no surface film or streaks, and to require no time-consuming toweling or polishing. Simple rinsing leaves the surface sparkling clean. Cleansing is based on physical action in lowering the surface tension of foreign matter adhering to the surface. Is claimed to have no effect on the vessel itself. Standard Scientific Supply Corp., 34 West 4th Street, New York 12.

Portable Test Sets

Two portable a.c. test sets are claimed to supply smooth test voltages from 0 to maximum rated voltages—2000 and 6000 volts. Either set can operate from any 115-volt, 50- or 60-cycle outlet, and both



have capacity of 2000 volt-amperes. Units are suitable for testing diesel-electric locomotives larger than 600 hp., as well as for industrial testing applications such as generators, motors, and motor parts. General Electric Co., Schenectady, N. Y.

Welder's Helmet

To give welders relief from obnoxious fumes, Cesco "Air Flow" welding helmet is claimed to reduce fatigue and improve worker morale, thereby increasing produc-

USE BATTERY TRUCKS *For Dependable Material Handling*

. . . ALKALINE BATTERIES
for Most Trouble-free Power

Time-saving material-handling operations being performed by battery industrial trucks—working 24 hours a day—are enabling all kinds of mills and factories to meet production schedules that seemed "impossible" when set up. Keeping work flowing continuously to and from machines and assembly lines on time, is a stop-and-go job in which battery industrial trucks excel because of their superior maneuverability, high availability and dependable operation.

With batteries exchanged two or three times a day, the truck is kept continuously supplied with power. While one battery is being charged, another operates the truck. Except for the few minutes needed to change batteries, the truck need not stop for servicing the power unit. Its electric-motor drives have a minimum of wearing parts and are inherently simple and trouble-free. The truck starts instantly; accelerates smoothly; operates quietly; gives off no fumes; consumes no power during stops. Not only does it make efficient use of power but the current used for battery charging is the lowest-cost power available.

Altogether the battery industrial truck is one of the most dependable and most economical methods of handling materials—especially when powered by Edison Alkaline Batteries. With steel cell construction, a solution that is a natural preservative of steel, and a foolproof principle of operation, they are the most durable, longest lived, and most trouble-free of all types of batteries. *Edison Storage Battery Division of Thomas A. Edison, Incorporated, West Orange, New Jersey.*

Edison
ALKALINE BATTERIES

In Industrial Trucks, Alkaline Batteries Give You These Important Advantages

- They are **durable mechanically;** grids, containers and other structural parts of the cells are of steel; the alkaline electrolyte is a preservative of steel.
- They **withstand temperature extremes;** are free from freezing hazard; are easily ventilated for rapid cooling.
- They are **simple and easy to maintain.**
- They can be **charged rapidly;** gassing cannot dislodge the active materials.
- They are **foolproof electrically;** are not injured by short circuiting, reverse charging or similar accidents.
- They can **stand idle indefinitely** without injury. Merely discharge, short-circuit, and store in a clean, dry place.

TIGHT VALVES *Save Fuel!*

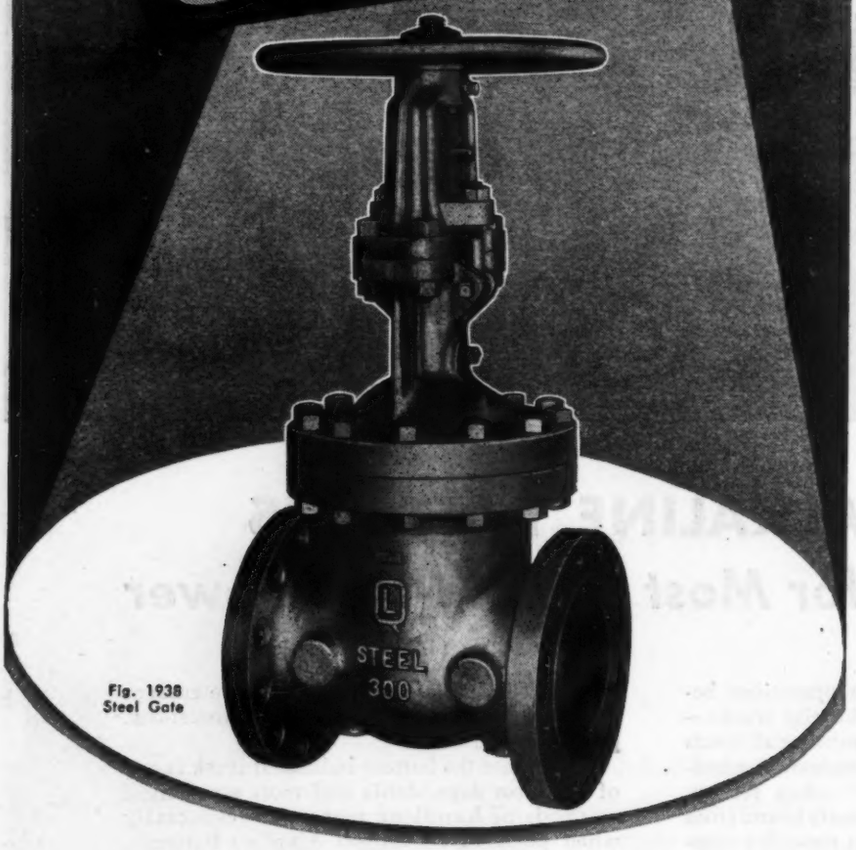


Fig. 1938
Steel Gate

...VITALLY IMPORTANT NOW, WHEN EVERY POUND MUST BE CONSERVED...

"MAN-MADE INFERNO!"

From this huge electric furnace, large quantities of molten steel are poured daily, for use in making castings for Lunkenheimer Steel Gate Valves . . .

Many elements in a piping system may contribute to ultimate fuel waste. Insulation may be inadequate. Piping and fittings may be defective. Or *valves may fail to hold tight* . . . resulting in leakage of steam, air or water, and in lowered pressures, all of which may mean *excessive fuel consumption.*

Lunkenheimer Valves—whether of steel, iron, or bronze—are *quality built to stay tight,* over years of service. They afford constant, dependable protection against leakage. Simplicity of design and a minimum of working parts assure extra long life and easy, economical maintenance.

We have prepared a chart, showing in dollars-and-cents figures, what leaky valves can waste in steam, water, and air. For your copy, write to The Lunkenheimer Company, Cincinnati 14, Ohio, U. S. A.

Lunkenheimer Valves

Branch Offices:
New York 13 Chicago 6
Boston 10 Philadelphia 7

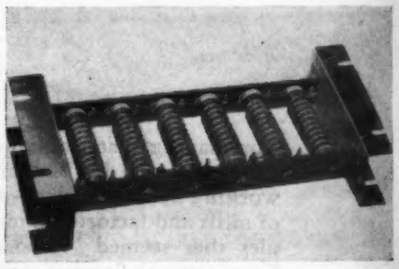
Export Department
318-322 Hudson St
New York 13, New York

The Lunkenheimer Nationwide Distributor Organization is always ready to help you with your problems of operation and maintenance. There is one near you with facilities for complete service.

tion. Clean, fresh air is fed into the helmet through a supply tube encircling the lens holder. Air flows gently along the shell and travels to outer edges, constantly circulating within the helmet. Directional flow of fresh air prevents stale or fume-laden air from entering, heat is cut down. Chicago Eye Shield Co., 2300 Warren Blvd., Chicago 11.

Resistor

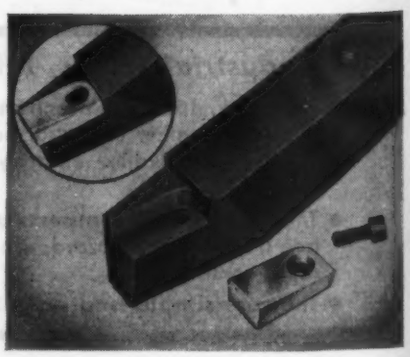
Bank-type resistor, for radiant heating installations, has unbreakable glazed steatite core for installation on moving machinery, or where subject to vibration or shock, as



well as continuous resistor element, of copper nickel alloy or chrome, that is replaceable without disassembling entire unit. Wide range in capacity and resistance values is claimed. Techtmann Industries, Inc., 828 North Broadway, Milwaukee 2.

Tool Blanks

Tool blank, having a drilled and counterbored hole to provide for attachment to steel shank with recessed-head capscrew, is announced. Angularly set screw holds the tip against recess walls that resist main cutting thrusts. Blanks are in several of the larger sizes, with formed clearance



They're different

they're improved Ermeto fittings!

Weatherhead Ermeto fittings are made in all sizes and types. They can be furnished in O.D. tube or in nominal pipe sizes from 1/8 inch to 2 inch O.D. Ermeto fittings for special installations are also available for a wide variety of uses. These fittings have been field tested and approved in thousands of installations on hydraulic, oil, water, gas and fuel lines. They will withstand excessive vibration for an indefinite period and hold beyond the burst strength of the tube itself. For information or literature, write or phone any Weatherhead branch office.

Write today for this new Ermeto catalog. It's free!

Look Ahead with Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND 8, OHIO

Branch Offices: New York, Philadelphia, Detroit, Chicago, St. Louis, Los Angeles

Morton's SALT TABLETS

NOW AS FAMILIAR AND NECESSARY AS THE DRINKING FOUNTAIN . . . .

Only a few years ago, the drinking fountain stood alone. Today, in practically all leading industrial plants, it has a partner, the salt tablet dispenser. For, wherever men work—and sweat — water and salt go together.

Salt is a balance wheel in the human body. It keeps body fluids in equilibrium and gives tone to the blood. When salt is lost the body becomes dehydrated and the blood thickens. The result is Heat-Fag, lassitude, inalertness. Production suffers and accidents increase.

The easy, simple, sanitary way to replace the salt lost through sweat is with Morton's Salt Tablets. It costs less than a cent a man a week to have them available at every drinking fountain.

In salt tablets, as with other grades and types of salt, Morton is the recognized leader. Order Morton's Salt Tablets and Dispensers from your distributor or directly from this advertisement. Write for free folder. Morton Salt Company, 310 South Michigan Avenue, Chicago 4, Illinois.

MORTON'S SALT TABLETS

Morton's Salt Tablets are available either plain or with dextrose.

Case of 9,000, 10-grain salt tablets - - - - - - - $2.60

Salt Dextrose Tablets, case of 9,000 - - - - - - $3.15

MORTON'S DISPENSERS

They deliver salt tablets, one at a time, quickly, cleanly—no waste. Sanitary, easily filled, durable.

800 Tablet size - - $3.25

MORTON'S SALT TABLETS

angles, right hand or left hand, and in standard grades. Completed tools of various styles—straight edge, lead angle, and offset, can be furnished with the screwed-on tips, or separate standard blanks can be supplied. Non-standard shapes and sizes are also available for special tools. Kennametal Inc., Latrobe, Pa.

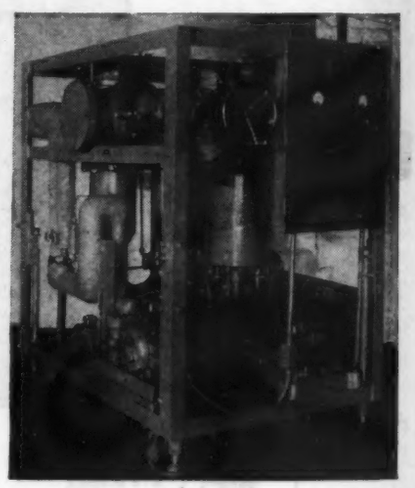
Adapter Fitting

No. 1517AT adapter fitting is for use where overfloor installations of No. 1500 Pancake Wiremold interconnect with Nos. 200, 500, or 700 surface metal raceway

installed on the wall. Ears are provided for fastening to the wall. Ample room for handling screwdriver aids in securing snug fit at junction between floor and baseboard. The Wiremold Co., Hartford 10, Conn.

High-Vacuum Pumping System

Type PS high-vacuum systems, in small compact units for direct connection to systems to be evacuated, are announced. Units are available in various capacities and

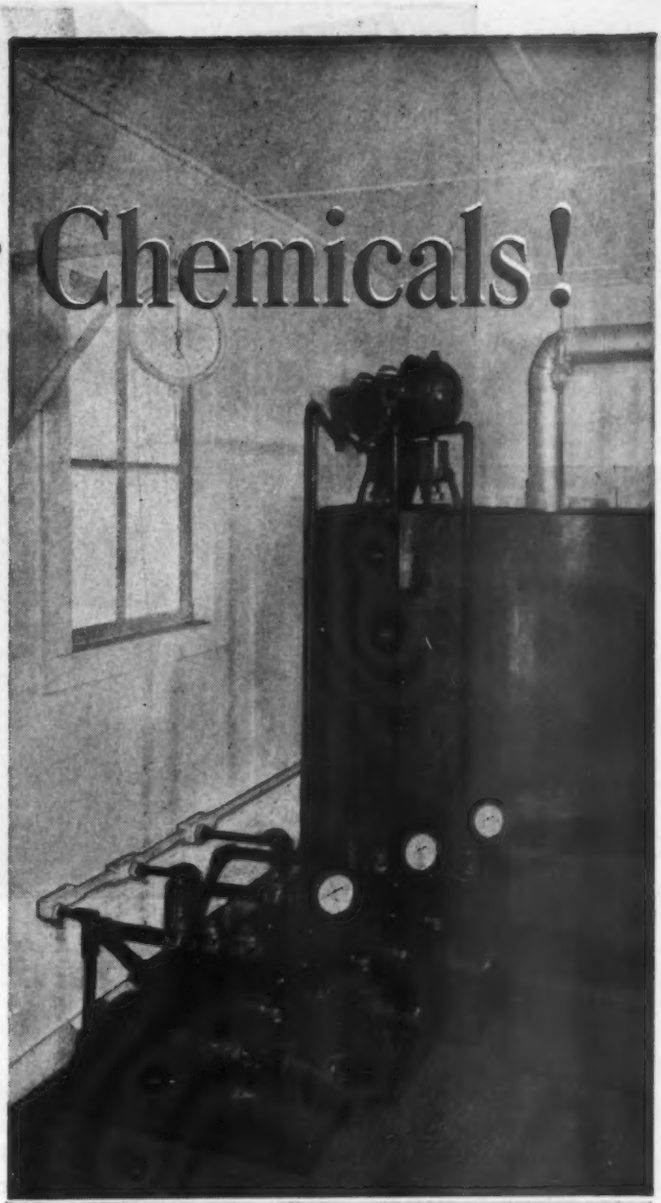


ultimate vacuum. PS systems are said to be simple to operate and to eliminate the necessity of setting up high vacuum pumping systems. Automatic and incorporates safety and protective features. Vacuum conditions are indicated continuously on control panel, and recorders may be used. Vacuum Engineering Div., National Research Corp., Boston 15.

Saw Lubricant

Lubricant for band saw teeth is in the form of a stick 6 inch. long and 1 inch in diameter. Applied by pushing stick against teeth of the saw blade while in motion. When used on metal-cutting saw, lubri-

Here's the Pump for Chemicals!



The R & M MOYNO

You make no "performance compromise" when you pump hard-to-handle chemicals with the *astonishing* R & M Moyno. It pumps everything from free-flowing liquids to non-pourable pastes.

LIKE NO OTHER TYPE OF PUMP

The Moyno meters quantities, discharges at high or low pressures without pulsation, handles abrasives, passes particles and solids in suspension, avoids high turbulence . . . and its simple pumping elements may be made of materials selected for *high resistance* to practically any type of chemical reaction. Illustrated is one of several hundred Moyno-equipped installations which chemically treat locomotive feed water for leading American railroads.

THOUSANDS IN SERVICE

The same unique abilities which make the Moyno such an excellent pump for chemicals also make it an outstanding performer on *every* type of service. Thousands of Moynos are in daily operation doing all kinds of pumping jobs well, working successfully where other pumps have failed—and saving their cost many times over in *lower* maintenance, *longer* life.

THE ANSWER TO YOUR PUMPING PROBLEM

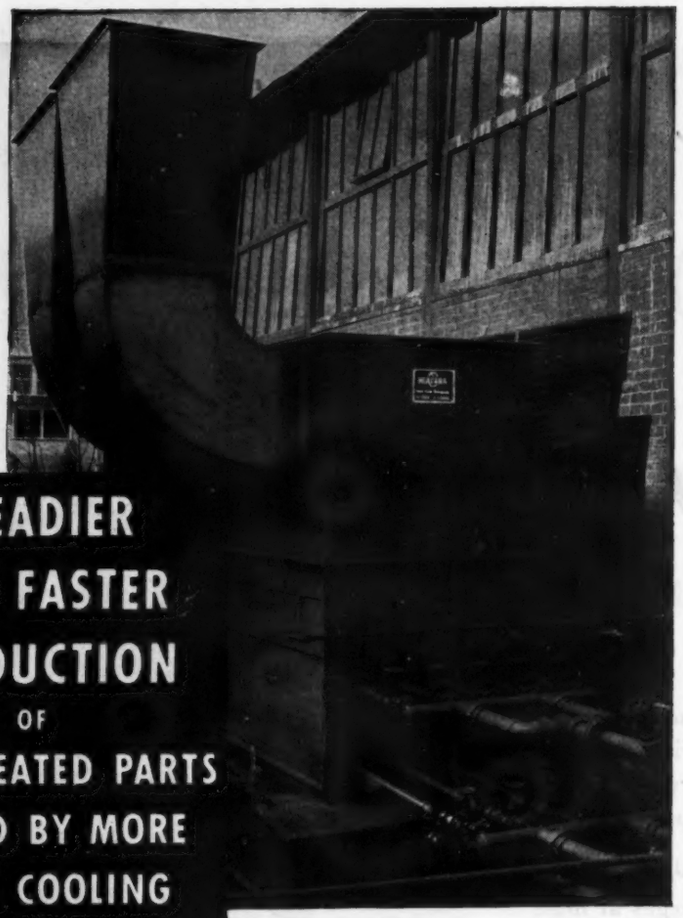
The Moyno will pump virtually everything that flows through a pipe. Would you like to learn more about it? Ask us for literature. Representatives in major industrial centers.

THE "STANDARD" MOYNO
(One of many types)

The pumping element consists of one moving part—a helical rotor revolving within a stator. There are no cylinders to score, no pistons, no valves or other small restricted openings imposing high velocity, yet the Moyno pumps with positive displacement and high reserve pressure. The Moyno eliminates "churning" action, delivers in uniform flow, yet it uses no portion of the housing as a sealing surface—has no end seal whatever.

ROBBINS & MYERS · INC. MOYNO PUMP DIVISION · SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co. of Canada, Ltd., Brantford, Ont.

MOTORS · HOISTS · CRANES · MACHINE DRIVES · FANS · MOYNO PUMPS · FOUNDED 1878



STEADIER AND FASTER PRODUCTION OF HEAT TREATED PARTS GAINED BY MORE RAPID COOLING OF THE QUENCHING BATH

U. S. Patent Nos. 2,296,946. 2,321,933. Re-Issue No. 22,553. Other Patents Pending.

● In a certain plant, heat treating equipment planned to complete five units in a given time period was unable to produce better than three until the NIAGARA AERO HEAT EXCHANGER was installed to cool and control the quenching bath temperature.

This increased production was the result of the extra capacity of evaporative cooling, the principal perfectly applied by the NIAGARA AERO HEAT EXCHANGER.

It also gives positive control of temperature which improves the quality of your heat treating and reduces rejections—and it saves 95% of cooling water costs.

Write for illustrated Bulletin No. 96

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

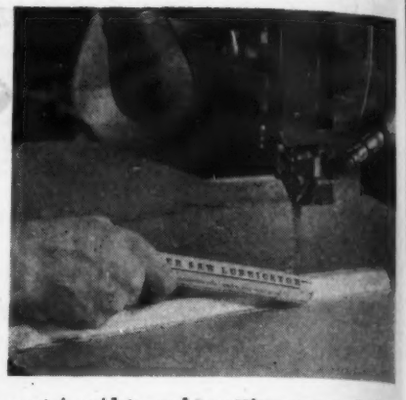
DEPT. FM-55, 6 E. 45th St. NEW YORK 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

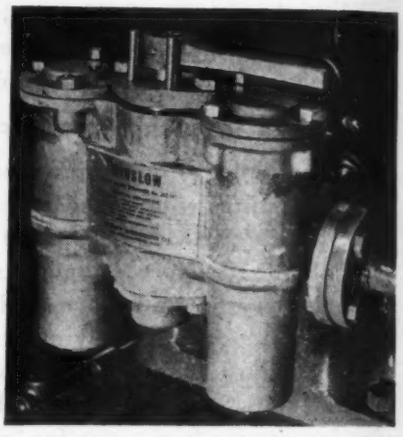
HUMIDIFYING • AIR ENGINEERING EQUIPMENT



cant is said to make cutting easy and fast, as well as to increase life of the saw blade. Also to prevent chips from clogging the teeth, reducing breakage. Kindt-Collins Co., 12651 Elmwood Ave., Cleveland.

Magnetic Strainer

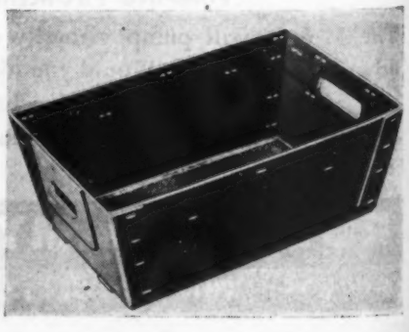
Model 200-MS-1 Duplex strainer is announced, for lubricating oil lines of steam turbines or other power equipment. Magnetic action and screening removes filings



and metal particles. Simple quick acting, hand-operated three-way control valve permits the change of flow from one strainer element to the other, or through both elements. Pressure regulating valve is adjacent. Two cylindrical baskets are constructed around a main body of perforated steel, with fine wire mesh linings. Inside spring-loaded bypass valve can be adjusted from the outside. Winslow Engineering Co., Oakland, Calif.

Fiberboard Containers

All-purpose, non-metal Toter can be used to handle electrical parts; surgical, office, and laboratory supplies; hardware, and other



THIS FOR SPOTTING CARS!

LO-HED CAR PULLER SAVES TIME, MONEY, BACK-BREAKING WORK

CAR SPOTTING need no longer endanger men or require frequent shifting engine service. One or more Lo-Hed Car Pullers set up at vital traffic points eliminates the waiting for a shifting engine and saves shifting charges.

One man can move cars whenever and wherever desired by just hitching a line around the puller barrel and pressing a button. That's all. Electricity does the rest!

Up inclines, on the level, around curves and corners, the powerful Lo-Hed Car Puller within its capacity hauls anything that rolls or slides. It can also perform any number of time-saving duties in and about your plant and on your siding.

Easy to install and operate, the Car Puller will pay for itself many times over. It's built by the makers of the famous Lo-Hed Electric Hoists. Write now for the descriptive folder containing complete details.

LIFT WITH A LO-HED HOIST...HAUL WITH A LO-HED CAR PULLER

OTHER Æ PRODUCTS:
Æ-TAYLOR and PERFECT SPREAD STOKERS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER, DIAMOND FACE GRINDERS

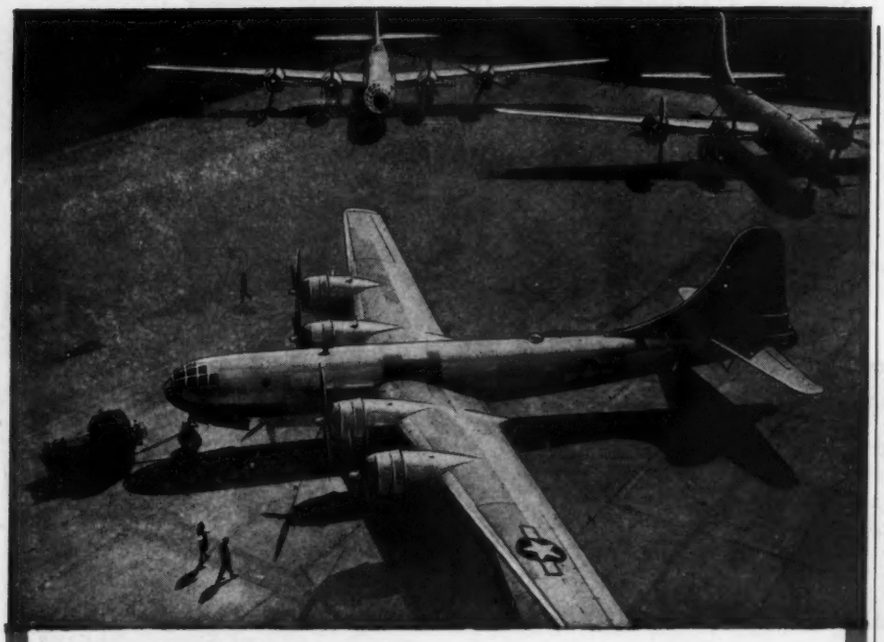
Æ AMERICAN ENGINEERING COMPANY

Subsidiaries: COCHRANE CORPORATION, FARADAY ELECTRIC CORPORATION

2426 ARAMINGO AVENUE, PHILADELPHIA 25, PA.

SEE YOUR CLASSIFIED PHONE DIRECTORY UNDER "Æ LO-HED HOISTS" FOR YOUR NEAREST REPRESENTATIVE

Copyright, 1945, American Engineering Company



LAMSON *Pneumatic Tubes*

Help Hurl More Bell-Built Superforts Against the Enemy!

The Georgia Division plant of Bell Aircraft Corporation is designed on a scale to stagger the imagination. A main building nearly a half-mile long!—nearly a quarter of a mile wide! A paint shop larger than many complete industries! Hangars almost 900 feet long! Vast distances between buildings!

The WRITTEN records necessary to run this tremendous plant must always be available. Responsibility must be accurately determined. To handle the terrific flow of reports, blueprints, memoranda, and orders—to move them speedily, safely —free from prying eyes—Lamson engineers installed a 12-mile network of pneumatic tubes. Secrecy is so important that each of the 48 receiving stations is equipped with a lock—which can be opened only by one with authority to handle the papers within. A signal light indicates important documents awaiting removal!

We've prepared a booklet called "WINGS OF BUSINESS" —telling you how these mechanical messengers can cut cost and speed the flow of business in your plant, store or office. A postcard will bring your copy. *Ask for it today!*

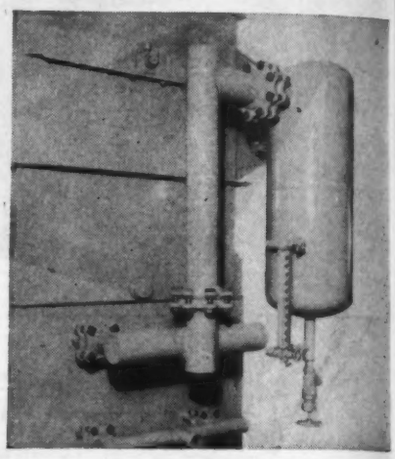
Operators at this central tube desk receive and dispatch carriers to all parts of the huge plant.

LAMSON CORPORATION
150 Lamson St., Syracuse 1, N. Y.

sundries. Constructed of impregnated, compressed fiberboard, containers possess enough "give," to make them suitable for glassware or other fragile articles. Sloping sides allow stacking to save space. Strengthened with extra reinforcement around handle slots. Wood cleats fastened to underside serve as skid bars to facilitate sliding and add strength and rigidity. Andrew Technical Service, 3553 N. Halsted St., Chicago.

Oil Separator

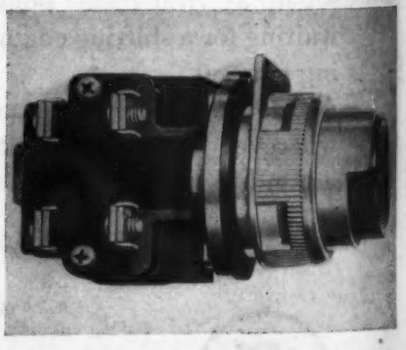
Apparatus, called Niagara Oilout, is claimed to remove oil from refrigerant gas as a part of the Duopass Aero condenser. Uses cylindrical drum located at the outlet



of the coil so that the refrigerant gas enters with a tangential motion. Coil reduces temperature of gas so that the oil vapor is condensed. Expansion of the system from a 4-in. pipe to a 14-in. drum reduces velocity of the gas so that the oil is easily removed and held by the wall and separator plates of the trap. Niagara Blower Co., 6 East 45th St., New York 17.

Pushbuttons

Class 9001 Type T pushbuttons, for group mounting on machinery or control enclosures, are claimed to be oil-tight, quickly and easily installed. They are compact and can be mounted on close centers. All terminal screws can be reached with screw-

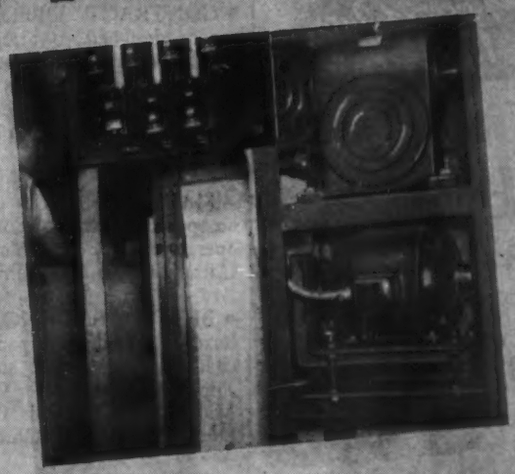


driver without going in at an angle. Unit is inserted through the panel and prevented from turning by a dowel. After the legend plate is slipped on, a thread ring clamps unit into position. Controller Div., Square D Company, 4041 North Richards St., Milwaukee 12.

IN STUFFY SPOTS

Many a motor must be located where walls, adjacent equipment, or materials cut down the free flow of air. Sometimes, as in the case of this wool-dryer drive, surroundings are hot, and stuffy, too.

Tri-Clad motors have proved themselves cool-running even under such conditions. Their powerful, double-end ventilating system moves the air at controlled velocity for effective heat removal. The location and baffling of dual exhaust ports discourage recirculation.



Tri-Clad motor drives conveyor on wool dryer—Bigelow Sanford Carpet Co., Amsterdam, N. Y.

AIR-FLOW TESTS OF TRI/CLAD MOTORS LEAD TO PROTECTION FROM OVERHEATING

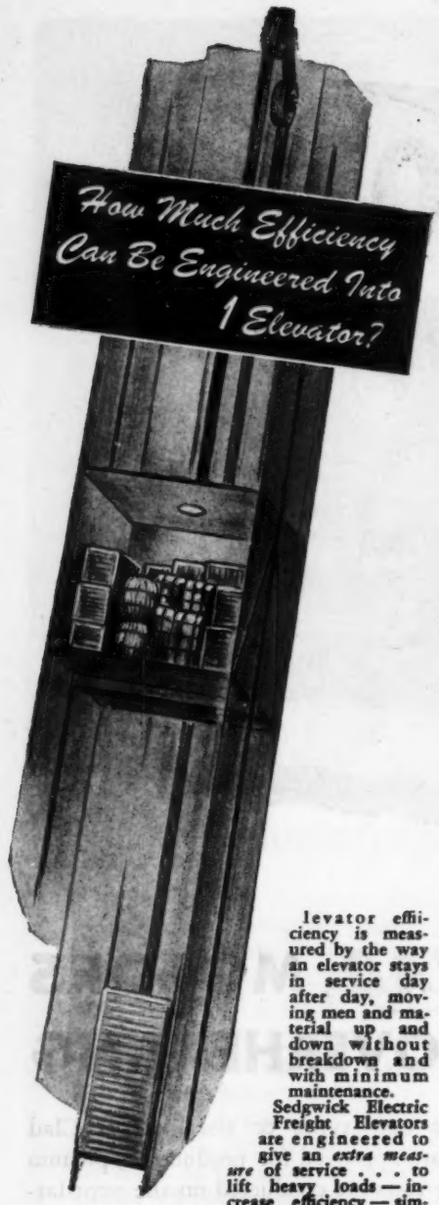
Plenum chamber test of Tri-Clad motor ventilation at G-E motor factory.

Before new types or sizes of Tri-Clad motors are approved for production, plenum chamber tests are conducted on the ventilating systems of sample models. These measurements serve as a check on previous calculations of the volume and velocity of air through the motor under different conditions. Other tests under load within enclosures and at abnormal ambient temperatures are also made. If your motors must be confined in stuffy spots, G.E. can help you make the right choice to beat the heat. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Buy all the BONDS you can—*and keep all you buy*



Elevator efficiency is measured by the way an elevator stays in service day after day, moving men and material up and down without breakdown and with minimum maintenance. Sedgwick Electric Freight Elevators are engineered to give an *extra measure* of service . . . to lift heavy loads — increase efficiency — simplify installation, repair and maintenance. And they are designed with many features for safe operation:

1. **Electro-magnetic brakes**
2. **Centrifugal speed governors**
3. **Special heavy duty motors**
4. **Self-aligning motor mountings**

Sedgwick makes five *standard* freight elevators with capacities from 2500 to 8000 lbs. But Sedgwick designs and manufactures elevators to lift any load. Fact is, today, on many aircraft carriers, fighting planes are lifted from hangar deck to flight deck on Sedgwick elevators — capacities, 85,000 lbs. and more.

Sedgwick engineers are ready *now* to help solve your vertical "man" handling and materials handling problems. Tell us about them.

Sedgwick Electric Elevators and Dumb Waiters are available only on suitable priority and delivery is subject to prior commitments to the Navy, Coast Guard, Merchant Marine and Army. Hand power elevators and dumb waiters are available without priority.

Sedgwick
MACHINE WORKS
138 W. 15th St., New York 11, N.Y.
ELEVATORS SPECIAL LIFTS
HOISTS DUMB WAITERS

YOU WANT TO KNOW

more about the items mentioned on this page

Letters to the addresses given will bring information

• CONTRACT OPPORTUNITIES, a service designed to bring contractor and subcontractor together, launched by Stanley Plan Corp., 60 East 42nd St., New York 17. (A further development of the Stanley Plan described in FACTORY, August, 1942, page 100.)

• MACHINE SPEED CALCULATING on special slide rule. For all metal cutting operations. Grove Calculator Co., 6644 Cottage Grove Ave., Chicago 37.

• BETTER SEALING of cartons and boxes when gummed paper is used. Wall chart illustrates eight steps. For use in shipping departments. Copies on request. Mid-States Gummed Paper Co., 2515 South Damen Ave., Chicago 8.

• PROTECTIVE COATING for magnesium. Paint Research Associates, 34 South River St., Aurora, Ill.

• SYNTHETIC SEALANT for impregnating cast aluminum and magnesium parts. Substitute for tung oil effective in preventing porosity of finely machined metals. Monsanto Chemical Co., St. Louis 4.

• CIRCULAR SLIDE RULE as hardenability calculator for steel. Applies standard formulas to figures on chemical composition and grain size. Steel & Tube Division, Timken Roller Bearing Co., Canton 6, Ohio.

• SPEED NUT LATCH of spring steel for attachment and removal of box covers, inspection plates, and similar. Spring arms snap over ball or grooved studs to provide firm attachment, yet studs may be quickly withdrawn. Tinnerman Products, Inc., 2096 Fulton Rd., Cleveland 13.

• DRILL LUBRICANT to avoid hole distortion and to overcome need for removing excess lubricant from work to be painted. Uses paraffin wax base, packaged in cylindrical cardboard containers. Aviation Lubricants Co., Box 1607, San Diego, Calif.

• BUSINESS BOOMS AND DEPRESSIONS since 1775 shown in colored graph. Issued with compliments of Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 6.

• HAND LABOR for sanding odd-shaped jobs may be avoided in many cases by use of wheel-type device having flexible, cushioned, abrasive surfaces. Abrasive cloth or paper is fed from coil at hub. Unit fits standard ½- and ¾-in. motor shafts. The Shaw Co., 816 West Fifth St., Los Angeles 13.

• SHEET-METAL ASSEMBLY without bolts, screws, rivets, or welds. Applicable to boxes, cabinets, shelves and other light metal structures. Uses Struc-Lok patented method of snapping together interlocking parts. Lindsay & Lindsay, 222 West Adams St., Chicago 6.

• PLASTIC that is fire- and shock-resistant, developed for U. S. Navy, also is free from toxic fumes. Uses asbestos fibers, bound with phenolic resins. Another type uses layers of glass cloth bound with melamine resin. General Electric Co., 570 Lexington Ave., New York.

• METALLIC COATINGS may be applied to glass and other materials by evaporation process of National Research Corp., Boston 15. Equipment recommended for coating low-reflecting optical surfaces, mirror-making, and electronic devices.

• GANG CHANNEL RETAINER for nuts and bolts has been redesigned to

ABRASION TESTING is done scientifically but easily by the Taber Abraser and accompanying accessories and materials furnished in kit. Applicable to all common types of materials and said to work on delicate and tough substances with equal precision. Taber Instrument Corp., N. Tonawanda, N. Y.

GUM STUCK THIS PLANT FOR PLENTY

SUN HYDRAULIC OILS . . . Ended Valve-Sticking in Hydraulic System of Milling Machine. Saved about $360 a Year Per Machine

Often, small changes permit a plant to increase its efficiency, to save money, and to eliminate costly "time-out" periods. This is especially true in specifying petroleum products, for each lubricant or oil must meet the particular requirements of a particular operation. For example:

A manufacturer was machining forgings on a big milling-machine, and ran into trouble with the oil in the hydraulic system that operated the machine.

Valves stuck, and gum had to be cleaned out at regular intervals. Production was being slowed down, and men were wasting valuable hours in cleaning-up machinery.

Gum vanished, and valve-sticking stopped after a Sun Oil Engineer was called in and recommended Sun's Solnus Oil. The oil met the requirements of the job and had to be "added-to" only once in five months. Maintenance-men were no longer tied to this machine. Savings were estimated at about $360 a year.

Wherever oil is used in your plant, whether in hydraulic systems, in machine-tools, in processing textiles, rubber, leather, or other materials; or for lubricating machinery, every oil should be fitted to its particular purpose—the right oil should be put in the right place. Let the skill, experience, and know-how of Sun Engineers help you solve your problems. Just write or call your nearest Sun office or . . .

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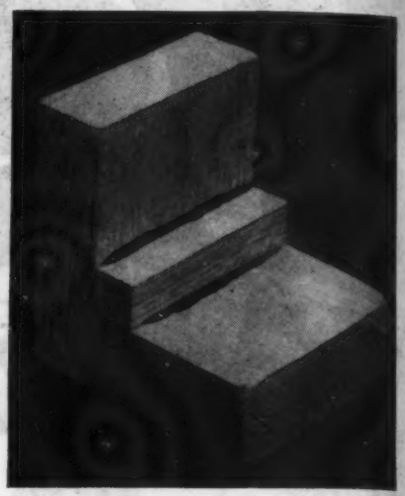
Logan Conveyorized receiving and shipping facilities get materials *in* and product *out* with less effort and manpower. Catalog No. 35 is full of handling ideas at work *now* in industries throughout the country. You may find some practical suggestion in it directly applicable to your own production flow problem. Send for a copy without obligation. Logan Co., Inc., 510 Cabel Street, Louisville 6, Ky.
Put flow INTO OPERATION
with Logan EQUIPMENT

reduce width, speed assembly, and strengthen locking. Engineering Dept. 1A, Kaynar Mfg. Co., 818 East 16th St., Los Angeles 21.

• BRUSH MARKER for stenciling, with continuous, controlled flow of ink. Diagraph-Bradley Stencil Machine Corporation, 3645 Forest Park Blvd., St. Louis 6.



ASSEMBLY GLUING under conditions that make application of high pressure impossible or too slow will benefit particularly, it is claimed, by use of a new urea-formaldehyde resin adhesive, named Urac 183. Photograph shows joint made stronger than the wood, itself, with only finger pressure applied in assembly. American Cyanamid Co., 30 Rockefeller Plaza, New York 20.

• STEEL PIPE RESEARCH PROGRAM outlined in booklet, "Research Points the Way." American Iron & Steel Institute, 350 Fifth Ave., New York 1.

NEW FILMS: Technical films, Nos. 1 and 2, on *Bakelite Plastics*, issued by Bakelite Corp., 300 Madison Ave., New York 17. No. 1 deals with the selection of a plastic suitable for a specific job. No. 2 shows fundamental principles of correct mold design and molding techniques. Both are 16-mm. with sound.

Story of a Transport, 16-mm. sound movie to promote Seventh War Loan. Also, *Midnight*, an 8-minute Navy film, and five Navy movie shorts. All available through Motion Picture & Special Events Section, War Finance Division, U. S. Treasury Dept., Washington, D. C.

There is an Engineering Reason, 16-mm. with sound, shows operation of valves, steam traps, expansion joints, and several related items. Yarnall-Waring Co., Chestnut Hill, Philadelphia 18.

All Work and No Play shows how special self-locking nuts help overcome vibration. Produced by Boots Aircraft Nut Corp. Distributed by Princeton Film Center, Princeton, N. J.

ELECTRONIC CONTROL OF FEED RATE

Thy-mo-trol drive operates the work feed on this Sundstrand-built "copy mill", which cut fin-milling time 35 per cent.

HELPS CUT FIN-MILLING TIME 35%

For one of the war's most vital machining jobs—aluminum cylinder heads for aircraft—the Sundstrand Machine Tool Company has developed a special machine which automatically mills fins on the walls of the forgings. Using this machine, a leading engine builder now completes these heads in 35 per cent less time than was required with a conventional feed drive.

Key to the increased production is optimum-speed machining, despite continual changes in depth of cut. G-E Thy-mo-trol drive gives precise control of feed motor speeds over a range from 175 to 1750 rpm. By means of its sensitive electronic control, it varies the feed rate automatically in inverse proportion to the load on the spindle motor. Light cuts go fast, deep cuts go slowly, and the fragile cutter required for this fin milling operation is kept loaded to the maximum safe working capacity.

Operated from an a-c power source, G-E Thy-mo-trol drive supplies closely controlled d-c power for stepless control of speed and torque over an unusually wide range. Thy-mo-trol drives are being "built-in" to all kinds of machines where power demands are between 1/8 and 25 hp. Grinders, milling machines, turret lathes, and thread mills are among the machine tools whose production has been stepped up by their use.

A co-ordinated set of equipment, Thy-mo-trol drive includes d-c motor, electronic panel, transformer, and control station. G-E engineers will help you select and apply Thy-mo-trol to your machines, or explore their suitability for new functions. Ask for Bulletin GEA-4025. *General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC

676-178-8980

THY-MO-TROL DRIVE

Buy all the BONDS you can—*and keep all you buy*

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THIS PROVEN
Tygon
Paint
WHERE OTHER PAINTS
HAVE FAILED

Tygon corrosion-resistant plastic Paint has been proven in the toughest service any paint is ever called upon to face—the vicious corrosive fumes in America's chemical plants. Here where the life of most paints is measured in months (sometimes weeks) Tygon Paint has stood up for 1, 2, 3, even 5 years.

Here's Why:

Tygon Paint is a liquid form of Tygon sheet stock, the flexible plastic used to line acid tanks. When applied by spray gun or brush, it forms a tough, impervious plastic "skin" that resists acids, alkalies, alcohols, oils, fresh or salt water.

OTHER THINGS ABOUT TYGON PAINT YOU'LL LIKE!

1 It will not become brittle with age.
2 Will not crack, craze, chip or weather.
3 As easy to use as any ordinary paint.
4 Flexible, elastic film withstands impact.
5 Cleans easily — gloss retaining surface.
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Significant Labor Developments

BENJAMIN WERNE, Lecturer in Government Regulations, New York University, Member of the New York Bar

Period Surveyed: March 10 to April 10

TREND INDICATORS

Jobbers Liable for Manufacturers' Violation

JOBBERS were recently held responsible for violations of their manufacturers despite the fact they were not aware of such violation. The Wage-Hour Administrator was denied the power of issuing an injunction against the jobbers where the violation had ceased; however, in the case of future violations, the Administrator may seek injunctive relief. (Walling vs. Friedman & Company, USDC S. N. Y.)

Deadline for Homework

The Wage-Hour Administrator has set April 15, 1945, as the deadline for employers to eliminate all except certain authorized homework. Only those homeworkers holding valid Wage-Hour Division certificates issued because (1) of the inability to adjust to factory work because of age, or physical or mental disability; or (2) the presence of the individual is required at home because of children; or (3) the individual is under the supervision of a state vocational rehabilitation agency or sheltered workshop, may continue their work under this order.

Held Under the Act

Employees engaged by an interstate grocery chain store to work in its warehouse and central office. The court found the company's wholesale activities to be distinct from its retail functions and held it not exempted by the retail establishment provision of the Act, since the employees involved were working in the wholesale establishment. (A. H. Phillips, Inc. vs. Walling, U. S. Sup. Ct.)

Employees engaged in the production of goods to be used within the state in carrying on interstate commerce. The Wage-Hour Administrator will call for compliance with this new interpretation by April 15 so that employers may have a proper period in which to make any adjustments necessary. The ruling will affect industries such as those engaged in the production of ice, electric energy, railroad ties, telephone and telegraph poles, and any such materials used or consumed wholly intrastate by interstate companies. (Wage-Hour Division)

Persons engaged in maintaining and repairing roads, highways, and bridges, despite the contractor's contention that he was employed by the state, was working on highways that were local in nature, and was not performing new construction but only repair and maintenance work. The court rejected the contractor's arguments, stating that he was an independent contractor separate from the state; that the roads involved were used by persons moving in interstate, and so were covered by the Act; that the distinction between repairing and new construction was irrelevant. (Walling vs. McCrady Construction Company, USDC W. Penn.)

Employees employed in any jobs incident to fishing, fish farming, or similar operations. If the employee spends more than 20 percent of his time in non-exempt work during the work week, he will be covered by the Act for that week. Where no segregation as to exempt and non-exempt work exists, and both types of work are performed, the employee will be considered non-exempt for that week.

WAR LABOR BOARD

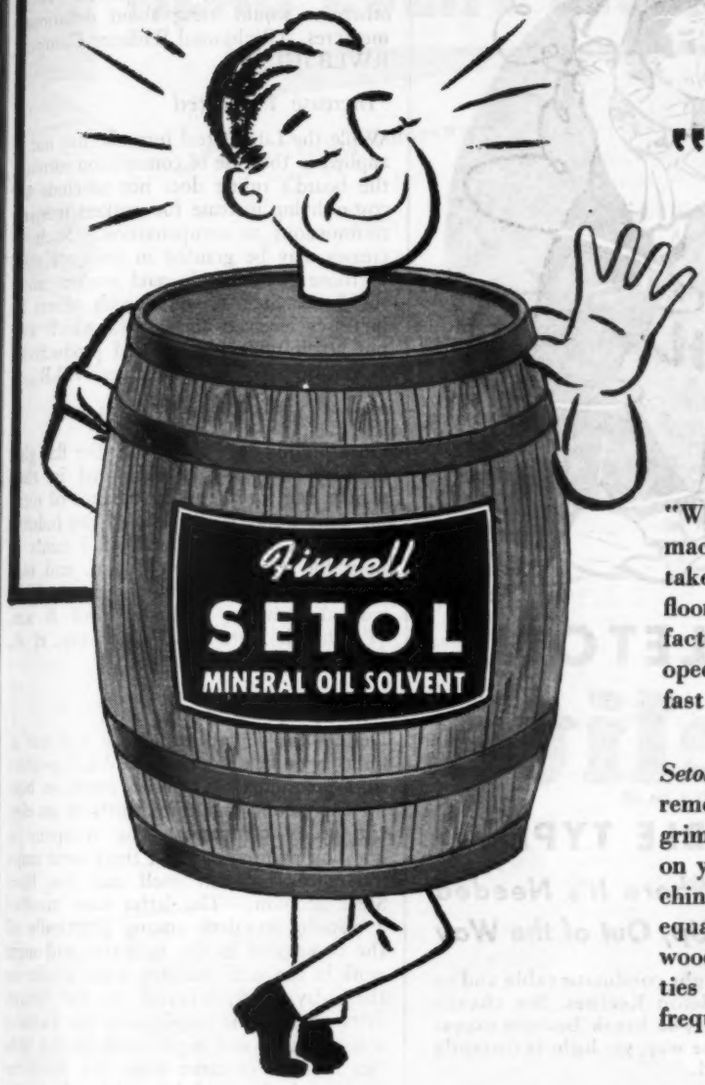
**25 Percent Hiring Rule Liberalized*

In lieu of the 25 percent hiring limitation, General Order No. 31 has been amended to allow rate-range employers to obtain approval of more flexible hiring plans, if they meet the following requirements: (1) Proof that rate-range minimums are at least as high as the appropriate approvable rate-ranges of the brackets set up by the board agency; (2) such definitions of jobs as to prevent unduly wide rate ranges or ranges that cover more than one job; (3) proof that objective standards for determining the suitability of applicants are in existence, and that these standards are uniformly applied.

**Wage Rates to Be Maintained*

Where a company reverted to peacetime production after a year's war work, a RWLB directed it to restore its pre-war wage schedules with a 10½-cent rate increase to match the increase the employees had received while performing war work. Although the job contents of the war and civilian jobs were different, the board felt the wartime rates justifiable on the ground that compensation should be allowed for

* In this and the following classification items marked with an asterisk also are considered to be trend indicators.



"I DON'T LIKE TO BRAG, BUT . . .

"When it comes to cleansers for use in scrubbing machines on factory floors, *Setol* has what it takes,—*speed!*" The chemical action of most floor-cleaning powders is too slow for their satisfactory use in scrubbing machines. *Setol*, developed expressly for that purpose, is amazingly fast . . . its chemical action is instantaneous!

Setol is a mineral oil solvent that penetrates and removes even the most stubborn coatings of grimy oil and grease. Yet it is thoroughly safe—on your floors as well as in your scrubbing machine. An all-purpose cleanser, *Setol* is used with equal effectiveness for cleaning painted walls, woodwork, ceilings. Contains no harmful properties that *clean away* the finish and discourage frequent cleaning.

Yes, *Setol* is the labor-saving answer to greasy, grimy cleaning problems. And it's so economical to use,—reaches saturation with one pound in ten gallons of water. Both soluble and sudsless. Compounded in *Finnell's* own powder mill, and put up in barrels, half-barrels, and quarter-barrels.

For literature or consultation, phone or write nearest *Finnell* branch or Finnell System, Inc., 2505 East Street, Elkhart, Indiana. Canadian Office: Ottawa, Ontario.

This is No Time to Let Down . . .
Let's Keep on Buying Bonds

FINNELL SYSTEM, INC.
Pioneers and Specialists in
FLOOR-MAINTENANCE EQUIPMENT AND SUPPLIES

BRANCHES IN ALL PRINCIPAL CITIES

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Reelite

Reg. U. S. Pat. Off.

PORTABLE TYPE

- *Light Right Where It's Needed*
- *Cord Reeled Up, Out of the Way*

Eliminate Accidents—to light conductor cable and to personnel—with Appleton Reelites. No chance for cord to kink, tangle, or break because excess is kept reeled out of the way, yet light is instantly available where needed.

Speed Up Production—Each Appleton Portable Reelite works on a ratchet stop so that cords are held at any length without tension. Convenience and ease of handling reduce time and fatigue—speed up production.

Cut Maintenance Costs—The rugged, sturdy construction of Appleton Reelites provides a lifetime of trouble-free reeling and hard usage—cuts cord costs to a minimum.

SEND TODAY

for this 50-page, illustrated Bulletin 504 on Appleton Reelites. Contains complete information on Constant Duty Types, as well as Portable. Also special Reels for air and fluid lines. Or, see Sweet's File, Page 2a/17.

Levolier socket with or without switch in handle. Heavy wire guard takes 40 to 75 watt lamps.

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the increase of wages and prices. To do otherwise would bring about deflationary measures. (Richmond Radiator Company, RWLB-III)

*Increase Permitted

While the Little Steel formula may not be applied in the case of commission earnings, the board's ruling does not preclude any cost-of-living increase for workers receiving commissions as compensation. Such increases may be granted in amounts equal to those given hourly paid workers under the Little Steel formula, with offsets for increases received since 1941 which were not attributable to increased productivity. (California Baking Companies, WLB)

*Shift Differentials Ordered

On a finding that workers in the flat glass industry were not compensated in their regular rate for the inconvenience of rotating shift work, WLB ordered the industry to initiate shift premiums of 3 cents an hour for work between 6 p.m. and midnight, and 6 cents an hour for hours worked between midnight and 6 a.m. (Pittsburgh Plate Glass Company, et al., WLB)

*Shift Premiums

Despite the contention that it was not an industry or area practice, a RWLB awarded shift premiums of 3 and 5 cents an hour for the second and third shifts of an electric utility company. The company in question pointed out that there were major differences between itself and the Basic Steel decision. The latter case involved a dispute prevalent among practically all the companies in the industry, and night work in the steel industry is more onerous than day work, whereas in the former instance only one employer in the industry was involved, and night work in the utilities industry is easier than day work because of the lessened demand for electricity. (Kansas City Power & Light Company, RWLB-VI)

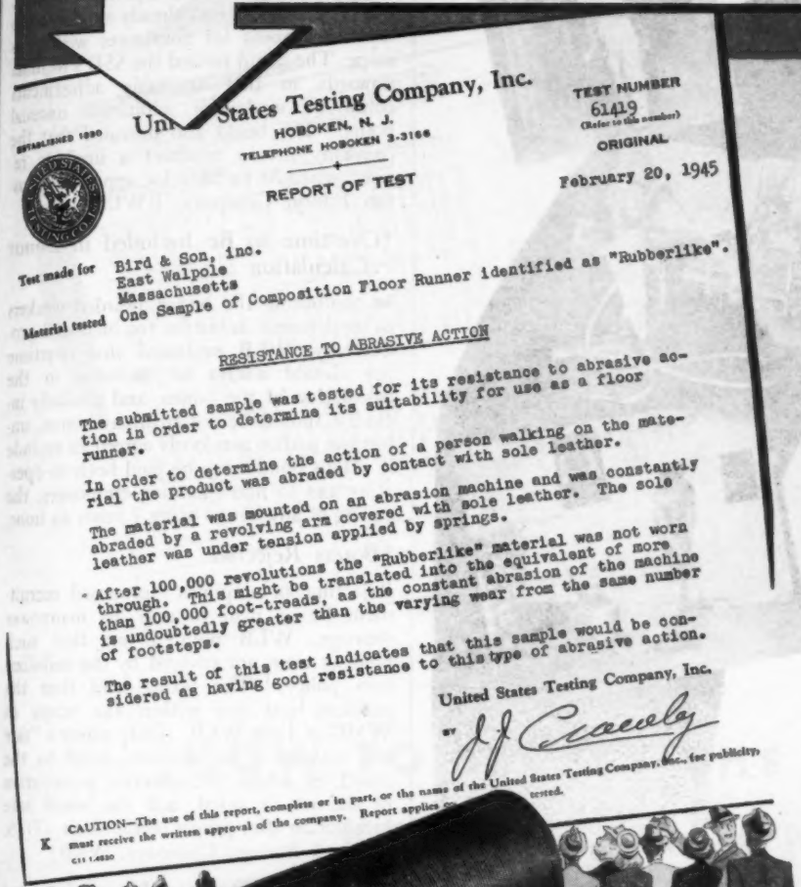
*Incentive Pay

In revising General Order No. 38, WLB rules that the incentive wage or piece rate excludes the commission method of payment. The board's order also provides that any part of a collective bargaining contract that conflicts with the order shall be effective only during the present term of the contract. The order restates the changes that may be made without board approval—namely, change in rate to reflect change in method, production, tools, materials, and design.

*Bonus Granted

RWLB awarded to members of a bargaining unit, which included both employees subject to SSU's jurisdiction and employees subject to WLB's jurisdiction, a bonus to compensate them for the increase of 8 hours in the work week. Instead of awarding uniform bonuses equivalent to time and one-half for work in excess of 40 hours a week, as the union requested, the board granted bonus in tapered percentage amounts beginning with 30 percent of

READ EVERY WORD OF THIS TEST!



United States Testing Company, Inc.
HOBOKEN, N. J.
TELEPHONE HOBOKEN 3-3166

ESTABLISHED 1880

TEST NUMBER 61419 (Refer to this number) ORIGINAL

REPORT OF TEST

February 20, 1945

Test made for Bird & Son, inc.
East Walpole
Massachusetts

Material tested One Sample of Composition Floor Runner identified as "Rubberlike".

RESISTANCE TO ABRASIVE ACTION

The submitted sample was tested for its resistance to abrasive action in order to determine its suitability for use as a floor runner.

In order to determine the action of a person walking on the material the product was abraded by contact with sole leather.

The material was mounted on an abrasion machine and was constantly abraded by a revolving arm covered with sole leather. The sole leather was under tension applied by springs.

After 100,000 revolutions the "Rubberlike" material was not worn through. This might be translated into the equivalent of more than 100,000 foot-treads, as the constant abrasion of the machine is undoubtedly greater than the varying wear from the same number of footsteps.

The result of this test indicates that this sample would be considered as having good resistance to this type of abrasive action.

United States Testing Company, Inc.
BY J. J. Crawley

CAUTION—The use of this report, complete or in part, or the name of the United States Testing Company, Inc., for publicity, must receive the written approval of the company. Report applies only to the specimen tested.

C11 1-4830

It proves conclusively that Rubberlike . . . the modern low-cost floor runner . . . stands up under the hardest wear

WE KNEW Rubberlike was good . . . that it was taking the toughest sort of punishment on just about every kind of heavy traffic floor. But we wanted proof — conclusive proof.

So the independent United States Testing Company, Inc., tested Rubberlike under a special walk-machine in their laboratory, to simulate months of grinding wear. And even after 100,000 pounding abrasive revolutions of this machine . . . "the equivalent of *more than* 100,000 foot-treads" . . . this laboratory now reports "Rubberlike . . . was not worn through."

And no wonder. Because Rubberlike was scientifically produced to provide better modern protection for any heavy traffic floor.

No installation is necessary; no special care. Just roll down this slip-proof, skid-proof and water-proof runner anywhere . . . and you'll make dangerously worn floors safe and easy to walk on, provide sure-footing on wet, slippery floors — and increase the life as well as lower the maintenance costs on any type floor.

Best of all you can order Rubberlike in the 36" width today from your local supplier. No priority needed. Or write Bird & Son, inc., East Walpole, Mass., for a free sample.

THE 10-SECOND STORY OF

RUBBERLIKE

WATER-PROOF · SKID-PROOF · PRESERVES FLOORS
LOW COST · HEAVY DUTY · NO SPECIAL UPKEEP
NO PRIORITY · HUGS ANY FLOOR · LONG LIFE
EXTRA RESILIENT · SPEEDS AND QUIETS TRAFFIC

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Page on Page of Practical Cleaning Ideas!

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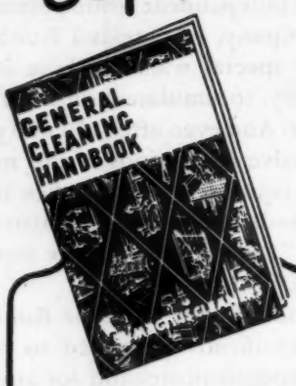

HOW TO CLEAN

FLOORS
CHANDELIERS
FURNITURE
ALUMINUM UTENSILS
WINDOWS
WIPER RAGS
AIR FILTERS
CLOGGED DRAINS
MACHINERY
HANDS AND SKIN
WALLS
SWIMMING POOLS
REST ROOMS
RUGS
LIGHTING EQUIPMENT
SHOWERS
DISHES
CEILINGS
MIRRORS
GARBAGE CANS
UNIFORMS
TOILETS
BUILDING EXTERIORS
TABLES
WOODWORK

Here's a how-to-do-it-and-why manual on the cleaning jobs faced by every building superintendent.

It will help you save money on the daily cleaning operations that have to be carried on in your plant buildings.

The Magnus General Cleaning Handbook will prove to be a frequently consulted and profitably used source of ideas on better cleaning methods which will not only cut cleaning costs, but improve cleaning results and eliminate the damages so often caused by using the wrong kind of cleaner.

MAGNUS CHEMICAL CO. 220 SOUTH AVENUE, GARWOOD, N. J.

Magnus Special Industrial Cleaners

LABOR DEVELOPMENTS *(continued)*

weekly compensation to lowest paid employees and ending with 5 percent for highest paid employees. The board's decision was based on the fact that SSU regulations require the tapering formula, and that the SSU had already approved the tapered formula for employees within its scope. The board revised the SSU's formula upwards so that equitable adjustments could be made for additional unusual hours. The board also provided that the company should resubmit a similarly revised schedule to SSU for approval. (Boston Edison Company, RWLB-I)

*Overtime to Be Included in Bonus Calculation

In computing the bonus awarded workers in local transit industries for increased productivity, WLB explained that overtime pay should always be included in the calculation of the bonus, and similarly included should be a Christmas bonus, unless the parties previously agreed to exclude it. This bonus may be paid both to operating and to non-operating employees, the ceiling of any bonus being 7 cents an hour.

*Bonus Rejected

Rejecting an employer's proposed recruitment bonus plan to ease his manpower shortage, WLB pointed out that such bonuses were not covered by the stabilization policy. The board held that the problem was one within the scope of WMC and not WLB. Only where a "rare and unusual" case presents itself to the board, or where the effective prosecution of the war is aided, will the board take jurisdiction after proper certification. (U.S. Spring & Bumper Company, WLB)

*Layoff Pay Deemed Unemployment Compensation

Board approval was not required for a proposed layoff plan under which the employer would pay his employees a "minimum week's wage" (70 percent of straight-time hourly earnings times number of hours worked weekly) for each 140-hour period of layoff, up to a maximum of 4 weeks' pay during any one year. The 140-hour period need not be consecutive, and unemployment for periods of less than 140 hours would be compensated for on a pro rata basis. The RWLB ruled that the payments due under the plan were not wages within the meaning of the Wage Stabilization Act, but rather were similar to unemployment compensation. (RWLB-III)

*Vacation Pay

In computing vacation pay, based on the "regular rate" paid employees as provided for in the contract, shift premiums are to be considered part of the "regular rate." The board based its decision on the fact that shift premiums are deemed part of an employee's "regular rate" when computing overtime compensation. (National Lead Company, RWLB-VII)

*Vacation Approved

A one week's paid vacation to those of a company's taxi drivers who have worked 4 or more days a week for 40 weeks during a

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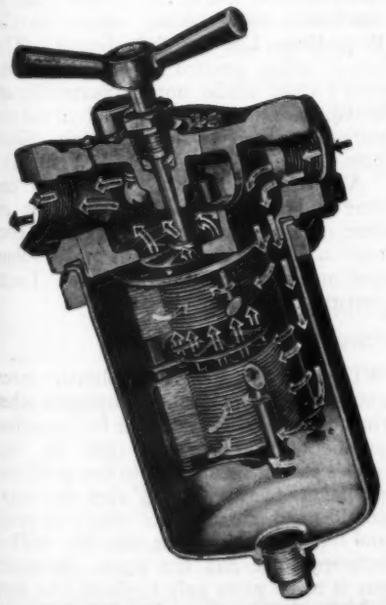

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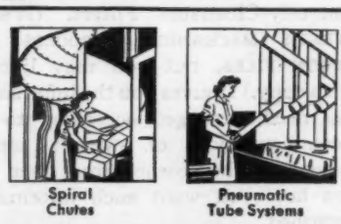

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vacation year was approved by WLB, despite the employer's contention that cab drivers do not need a vacation since they can take time off whenever they do so desire. (Sunshine Cab Corporation, WLB)

Vacation Granted

Overruling a company's claim of creating intraplant inequities, RWLB granted to the company's warehousemen a vacation award of two weeks after five years' service in addition to one week of vacation after one year's service, which they were entitled to under a prior contract. The board pointed out that the group of warehousemen were not bound by the demands of any other unit of employees in the plant which did not have similar vacation benefits. (Brown & Haley, RWLB-XII)

*Unpaid Rest Period a Violation

Because it provided a 10-min. unpaid rest period for its employees, a firm working under government contracts was held in violation of the overtime requirements of the Walsh-Healey Act. The Administrator pointed out that the rest period was for the employer's benefit primarily, since it was of too short a duration for the employee to pursue their own needs. (William E. Lipshutz, W-H Adm.)

*Overtime Ordered

In accordance with area practice, a group of local laundries were ordered to pay overtime for hours worked in excess of 40 a week, although such was not the practice of the laundry industry in the area. The board explained that the area practice was established because of the concentration of non-ferrous metal mines subject to the Wage-Hour Law in that district. The board further pointed out that the company's costs would not be materially affected, since the employees involved did not work more than 42 hours a week. (Silver Bow Employers' Association, RWLB-IX)

A bus company was directed to pay time and one-half to drivers working on their days off, despite the company's contention that the overtime was purely voluntary and never required. (Akron Transportation Company, RWLB-V)

*Severance Pay Approved

WLB recently approved a voluntary severance pay plan for salaried employees when the company reduces its staff for peacetime production. The plan calls for one week's pay for six months' to one year's employment, two weeks' pay after one year's employment, three weeks' after two years, and four weeks' for those who have worked between three and five years. Severance pay is to be given only to those who were discharged through no fault of their own. (American Type Founders, Inc., WLB)

*Nonpayment for Holidays Not Worked

Despite the fact that about 60 to 70 percent of all industrial and non-industrial employees in the area received paid holidays, RWLB denied pay to employees of a lime and transport company for six annual holidays not worked. The board

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based its decision on the fact that the union failed to show that such payment was a practice in the industry in the area, or a generally prevailing practice among industrial employers in the area. The board maintained that it would not initiate paid holidays in an industry unless the practice was so prevalent in the area that non-payment by some employers would cause friction. (Kelly Island Lime & Transport Company, RWLB-II)

*Decreases Denied

WLB announced that it would not approve wage decreases below the highest wages paid for that particular work between January 1, 1942, and September 15, 1942, except in cases involving the correction of gross inequities or to aid the successful prosecution of the war.

The board refused a company's request to reduce the wages paid to its plant guards, which wages were in accordance with Army requirements while the company was performing an ordnance contract. Although the company explained that its contract was completed, and it wished to revert to the scale in existence between January 1, 1942, and September 15, 1942, the board denied the request because the nature of the work was unchanged, and the adjustment was not required to correct gross inequities or aid in the effective prosecution of the war. (Cuneo Press, Inc., WLB)

Another company's request to convert its wage scale from a weekly salary to an hourly rate range, so that the maximums of the majority of the rate ranges would be substantially equivalent to the present weekly salaries, was denied by the board on the ground that the change would reduce the company's wage scale below the highest wages paid between January 1, 1942, and September 15, 1942. (Anderson's Super Service, WLB)

*Veteran's Right to Reinstatement

Mere announcement of his intention to return to work within 90 days after discharge from the armed services is sufficient to establish a veteran's claim to his former job. He need not, as one company required, fill out new bonding and hiring applications in order to be reinstated in his former job. (Goodyear Tire & Rubber Company, RWLB-VI)

*Retroactive Back Pay for Veterans

Where reinstatement was wrongfully refused a returning veteran, a federal district court held that the back pay due him was to begin from the date of the returned veteran's filing of suit rather than from the date of the employer's refusal to reinstate him. A period of six months had elapsed, in this case, between the date of his discharge from the armed forces and the date of the suit. The court reasoned that the back pay feature of the Selective Service Act was not a punitive measure against the employer, but rather an aid to the veteran. Therefore, inasmuch as the veteran was found capable of pursuing his profession without statutory help, he was granted only that which would effectuate the pur-

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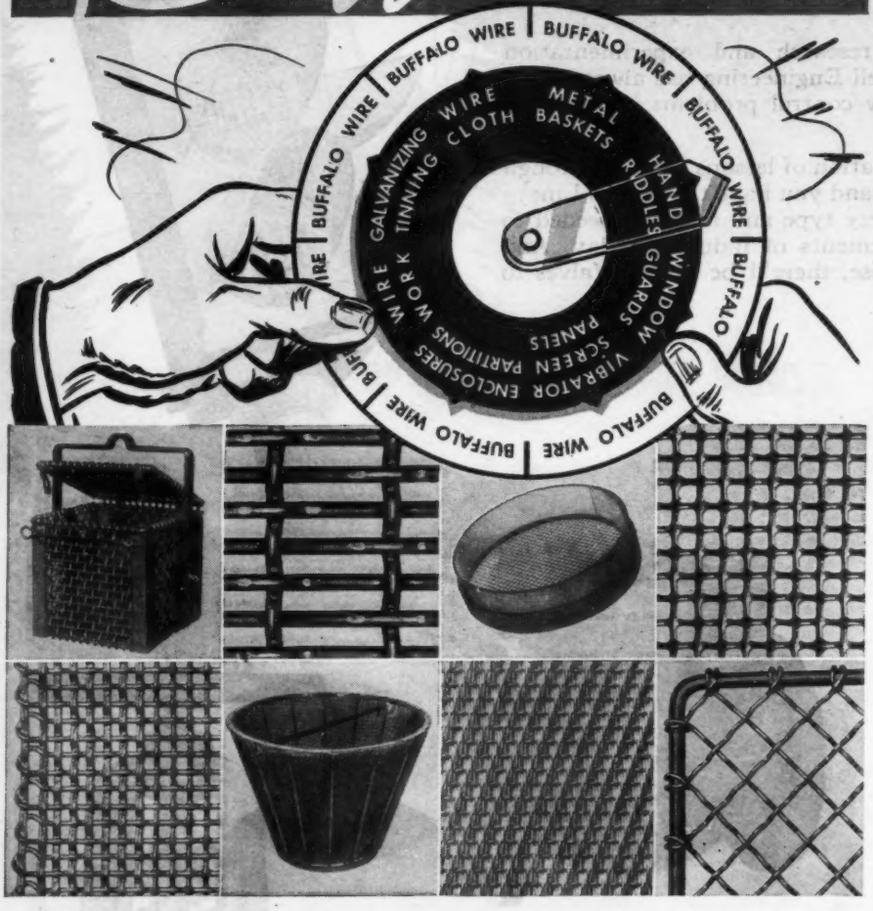

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poses of the Act. (Kay vs. General Cable Corporation, USDC N. J.)

RWLB Orders Clause Extended

RWLB directed a company to extend from its old contract, into its 1944-45 contract, a clause providing for a 48-hour work week guarantee with time and one-half for hours worked in excess of 40 a week. Included, however, was a provision permitting either party to initiate proceedings should the manpower situation necessitate a change in the agreement. (Phillips Petroleum Company, RWLB-VII)

**Board Denies Request to Revoke Union Security*

Declaring that it is not its job to police contracts, a RWLB refused an employer's request to revoke check-off and maintenance of membership because of the union's strike in violation of the contract, and the union's request for pay due employees for time lost from work where they were allegedly locked out by the company. The board, however, did point out a specific procedure for settling the dispute. (Independent Manufacturing Company, RWLB-III)

In another case the same board refused to change a maintenance-of-membership contract so as to include an escape period provision on the ground that the company's negotiators had agreed to the original omission. The company's board of directors refused to ratify the contract with the omission, but the board maintained that to make the change would upset the bargaining process. (Victory Products Corporation, RWLB-III)

**Check-Off Granted*

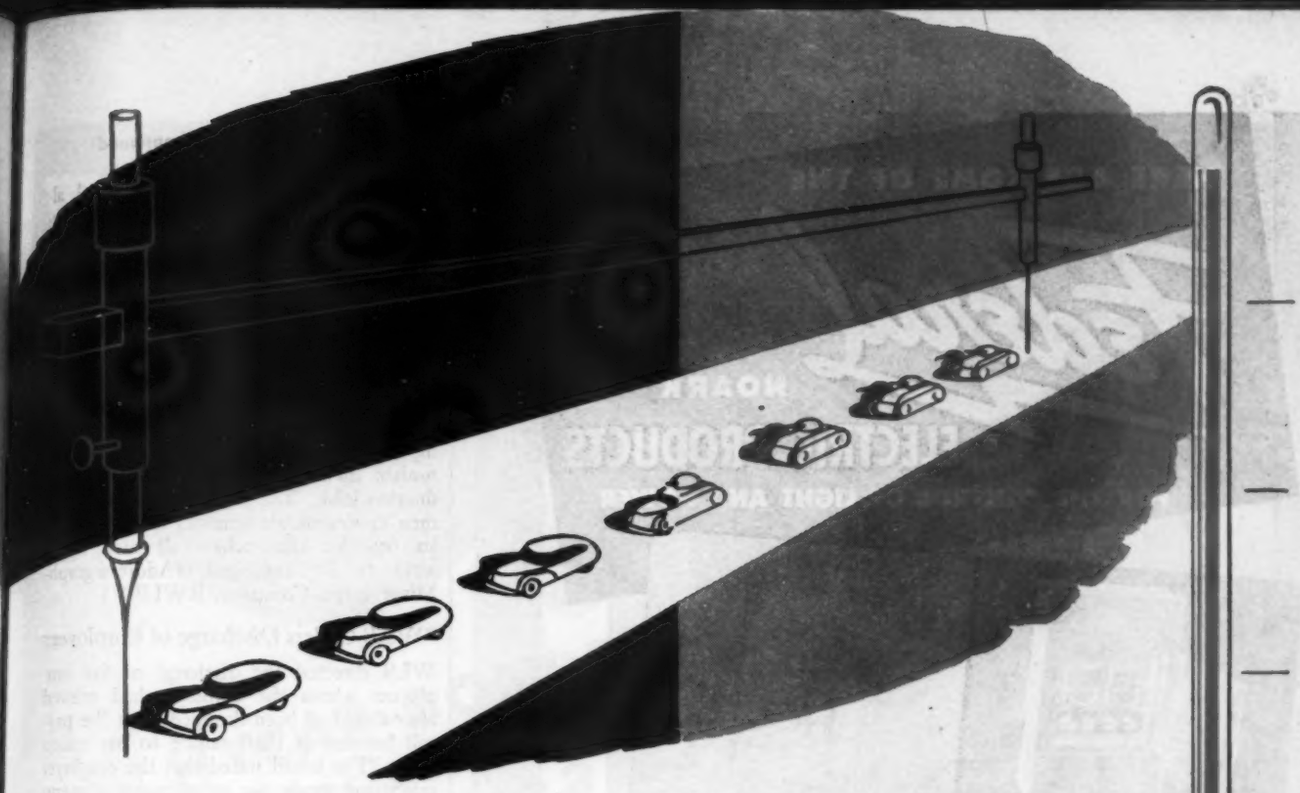
Check-off, in addition to retention of a maintenance-of-membership clause, which the employer sought to eliminate, was directed by WLB where the union established that check-off as necessary to protect it against the company's past tactics. (General Motors Corporation, WLB)

Union Charged With Blacklisting

Because it contended that the union violated its maintenance-of-membership clause by making members who wished to withdraw from the union during the 15-day escape period sign "withdrawal forms," the company involved petitioned WLB to revoke the maintenance-of-membership and check-off provisions granted. The forms waived the member's claim to any retroactive pay under a WLB order, his claims to union assistance with respect to other provisions of the order, and, all in all, to further union activity. The union disclaimed such coercion, but averred that if such were the case, grievance procedure or arbitration should be the proper machinery for such matters. (Timken Roller Bearing Company)

**Seniority Granted*

Top seniority was awarded to five union officials by RWLB where 40 of the company's 63 pre-war employees were due for reinstatement under the Selective Service



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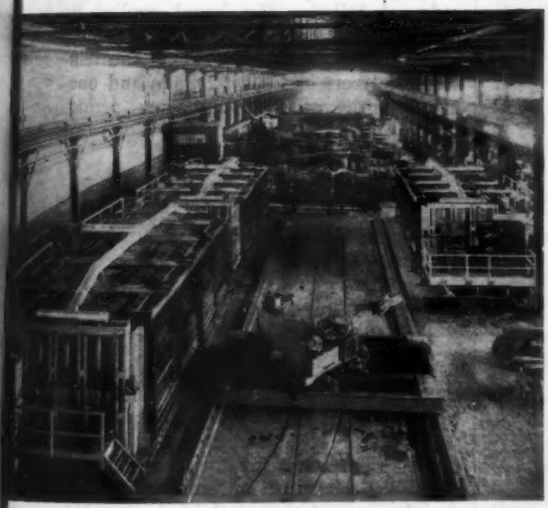

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LABOR DEVELOPMENTS *(continued)*

Act. The board held that such award, although made subject to the Selective Service Act, was essential to the maintenance of labor-management harmony. (Fisher Scientific Company, RWLB-III)

*Foremen Denied Seniority Rights

Despite the company's contention that foremen are employees within the meaning of the Wagner Act, RWLB denied its request to allow supervisory employees promoted from the ranks to retain and accumulate their seniority rights in their production jobs. The board allowed the foremen to accumulate seniority for a period of six months, after which all such rights were to be expunged. (Addressograph-Mimeograph Company, RWLB-V)

*WLB Orders Discharge of Employees

WLB directed the discharge of five employees whom the employer had rehired after they had been dropped from the payroll because of their failure to pay union dues. The board stated that the employer might not evade the maintenance-of-membership contract by such rehiring. If he wished to reinstate the workers, the latter must first restore themselves as members in good standing in the union. (Lamson & Sessions Company, WLB)

*Striking Employees Penalized

Where the board found the employer's anti-union actions largely responsible for a strike, it denied him the privilege of disciplining the strikers after they had been reinstated pursuant to a back-to-work order of WLB. The board applied its own sanction against the employees because of their strike by denying the reinstated workers back pay for one and one-half months of their discharge period. (Automatic Transportation Company, WLB)

NATIONAL LABOR RELATIONS BOARD

*State's Labor Restraints Unconstitutional

A special three-judge federal court deemed the provisions of the Kansas Union Control Law calling for the prohibition of strikes except by majority vote, jurisdictional strikes under any circumstances, and economic boycotts unconstitutional restraints upon free speech and assembly. The state's rights, however, to require union registration, licensing of business agents, and majority votes before entering into union shop contracts were upheld by the court on the ground that such statutory provisions would not violate the constitutional rights of labor unions. (Stapleton vs. Mitchell, USDC Kan.)

*Foremen's Union Recognized

Reversing its Maryland Drydock decision, NLRB now recognizes the foremen of a motor car company as constituting an appropriate unit for collective bargaining purposes. The board deemed foremen "employees" within the meaning of the

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LABOR DEVELOPMENTS *(continued)*

Wagner Act, and maintained that the Act dictates such decision for effectuating its purposes. No course of action is set forth in the event related unions represent both production employees and foremen. (Packard Motor Car Company, NLRB)

*Injunction Against Union Denied

An employer was denied an injunction against a striking union which had lost an election conducted by the Labor Relations Board and was now attempting, through the strike, to force the employer to recognize it. The court refused the injunction because it found that the dispute was a jurisdictional one which started before the election. Since the Wagner Act does not require a union to cease a labor dispute because of the certification of a rival union, the court held the dispute protected by the Norris-La Guardia Act. (Yoerg Brewing Company vs. Brennan, USDC Minn.)

*Appropriate Unit

NLRB, basing its decision on a job description drawn up by WLB, excludes leadmen in an aircraft plant from the classification of supervisors on the grounds that they are heads of groups of no more than 20 production workers; they spend majority of their time performing work similar to that of the group; and they do not pass on wages, employment, or discharge of employees. (Northrop Aircraft, Inc., NLRB)

Irrespective of the past history of collective bargaining in the plant, and in keeping with the desires of the employees involved, NLRB allowed nine craft units to separate from the industrial unit previously established and act as bargaining agents within their own spheres. The craft units had retained their identity and organization and did not, as the board viewed their actions, forfeit any of the rights with respect to representation. The prior decision, as explained by the board, had been made before the new policy on craft units had been completely worked out. (Phelps Dodge Corporation, WLB)

Although it did not have a constitution, bylaws, or charter, an employees' association was deemed an appropriate bargaining agents where it was not the practice of the international organization, with which it was affiliated, to issue a charter until the organization was established or had had bargaining relations with the employer. The board pointed out that the union displayed its objective by issuing membership cards, holding a membership meeting, and seeking to engage in collective bargaining with the employer. (Gielow, Inc., NLRB)

*Policing Labor Relations

Indicative of its function as a policing body, NLRB threatened revocation of certification of two unions, dissatisfied with the units established, if they engaged in reprisals or failed to represent the employees involved without discrimination.

In another instance, although no punitive action was contemplated by the board, the latter ordered an employer to bargain with the certified union, despite the fact that the rival unions threatened the employer with wildcat strikes if he were to

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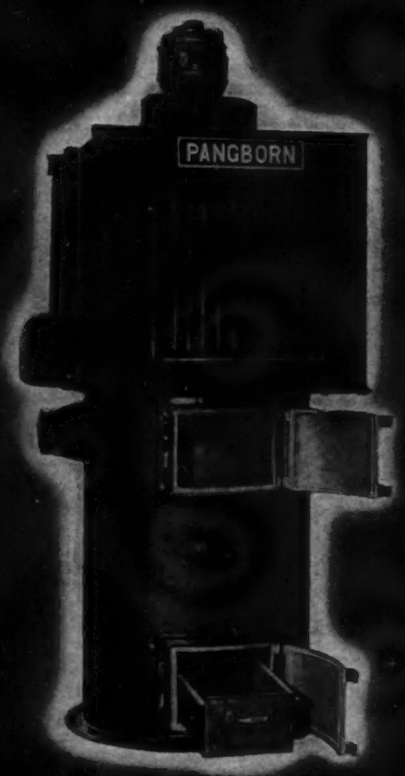

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so bargain. (RKO Radio Pictures, Inc., NLRB; National Broadcasting Company, NLRB)

Held Subject to Wagner Act

Despite the fact that a cement manufacturer transformed his operations by substituting intrastate purchases and sales for interstate purchases and sales after the Labor Relations Board had begun an investigation of charges of unfair labor practices, the court held that he was not removed from the authority of the Wagner Act. The board has authority over all operations affecting interstate commerce, and materials purchased from persons within the state have come from outside the state. Since the dispute makes for an interruption in interstate commerce, it is covered by the Wagner Act. (NLRB vs. Cowell Portland Cement Company, CCA-9)

Held Refusal to Bargain

The fact that one voter who participated in a consent election to determine the bargaining agent was not an employee, was held no justification for the employer's refusal to bargain with that union. Although it was this individual's ballot that caused the union to win, the board held the employer's challenge too late to be justified. (A. J. Tower Company, NLRB)

**Held Interference*

When an employer created the impression among his employees that an NLRB conducted election was being sponsored by him, the board found him in violation of the Wagner Act. In the case involved, the employer had engaged in a campaign to get out the vote against the union, had spent time, money, and energy to arrange the election with himself as the "official" source of information, had distributed anti-union speeches of its officials, and had claimed recently approved wage increases as a recompense obtained for his employees despite the opposition of one union. (Famous-Barr Company, NLRB)

Because it aided an employer in the latter's anti-union conduct, a farmer's association, with which the employer was associated, was found in violation of the Wagner Act. The association, upon being informed by the employer that his employees desired to organize a union, warned the employees that no unionization would be tolerated in the area. (NLRB vs. Holtville Ice & Storage Company, CCA-3)

An employer was deemed in violation of the Wagner Act because of his threats to abolish overtime work and install a time clock if his employees joined the union; because of this declination to deal with the union pending the final outcome of a consent election, which was first insisted upon by him and then delayed by withdrawal of his consent; because he maintained that he would put into effect a lower wage scale if wages were included in the contract; and because of his refusal to make counterproposals with respect to the wage and hour proposals of the union. (Twin City Milk Producers Association, NLRB)

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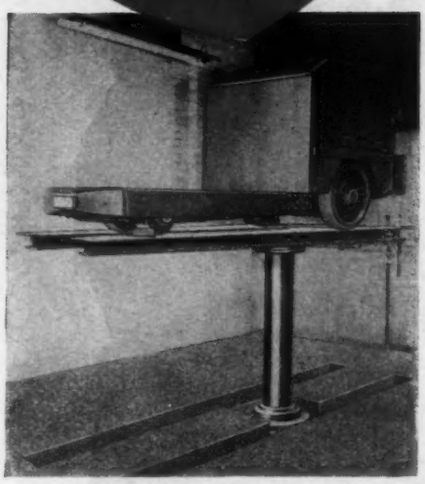

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Present and Future WLB Policies

GEORGE W. TAYLOR, National War Labor Board, before the Personnel Conference of the American Management Association

A gratifying omen of our ability to meet whatever problems may be ahead is the recent charter created by representatives of the CIO, AFL, and the U. S. Chamber of Commerce. The performance of the functions of collective bargaining and of private management in a free enterprise system has been mutually recognized and accepted as the way in which a more prosperous economy can be attained in our democracy. The approval of these basic concepts gives a sound framework within which future questions can be resolved by men of good will. . .

I have been asked to talk about the National War Labor Board and its policies. In doing so I shall attempt to consider the effect of the policies followed by the board upon the adjustment problems of the future.

The War Labor Board, as it was set up by Congress and the President, has two principal functions:

1. To settle labor disputes without loss of war production.

2. To stabilize wartime wages as part of the fight against inflation.

Let me discuss them in that order. When America was drawn into this war, it was immediately evident that we simply could not produce the necessary supply of war goods if strikes were to be permitted to interrupt production. Two courses were open to the nation—passage of a law making it a criminal offense, perhaps, to strike; or voluntary acceptance by labor and management of governmental arbitration of their disputes.

We wisely decided that maximum war production could best be achieved through control of the right to strike by voluntary agreement. . .

But whether the controls are voluntary or compulsive, you can't just say "There won't be any strikes." Machinery must be provided to settle disputes which might cause strikes.

For this purpose a War Labor Board was set up, consisting of representatives of labor, industry, and the public, finally to resolve all labor disputes which might hinder the prosecution of the war. . .

The availability of a governmental agency charged with final settlement of every type of labor dispute has made it difficult to use collective bargaining to perform its full function. Both management and labor have developed a tendency to pass disputes to the War Labor Board rather than to assume the responsibility for making a settlement. That is a situation which should be reversed as soon as possible. Both management and labor have surrendered peacetime rights during the war, just as all citizens surrender some of their liberties during war. But both industry and labor should be looking forward to the day when these collective bargaining rights will be fully exercised. When we look ahead and realize the magnitude of the adjustment problems we shall face in every workplace, I think most of us will agree that most of those problems can better be settled through collective bargaining back home in the factory than by government designation of the terms of contracts. . . .

In all earnestness I say to you, if the nation is going to have a system of industrial relations capable of assuming the burdens which lie ahead, it must develop collective bargaining as an institution functioning in the common interest.

This job should be undertaken immediately through a program of labor and industry aimed at more collective bargaining agreements and fewer directives. . .

A resumption of the right to exercise strike and lockout pressures need not be accompanied, however, by an epidemic of interruptions to production. Such a result would be detrimental not only to the production of needed civilian goods and the rapid reemployment of workers, but also to the interest of the participants if the issues can be otherwise resolved. A postwar labor relations program should center upon the making of voluntary arbitration procedures available to the parties to a labor dispute and to make voluntary arbitration desirable to both parties. . . The essence of any program for industrial and labor relations in our democratic country must be voluntarism. Our obligation as citizens in a democracy is to build a voluntary system for minimizing strikes and lockouts.

Stabilizing Wages

The second major responsibility given to the War Labor Board is that of stabilizing wages in wartime America. . . On April 27, 1942, the President presented to Congress and to the people a seven-point program for fighting inflation. In the portion of that program dealing with wages he said that no further wage increases should be made except to correct inequities or to aid in the prosecution of the war. . .

Why did the nation—through the War Labor Board—have to adopt a wage stabilization program? It is cerainly novel in American industry to decide that a worker cannot get a raise even if the employer may be willing to give it to him.

There are three reasons making it imperative to stabilize wage rates in wartime as a part of a general stabilization program: (1) To help control the so-called inflationary gap between current income and the civilian goods which could be bought; (2) to help control the movement of manpower into war production; and (3) to help control prices.

As to the first point, there has been much exaggeration of the extent to which excess purchasing power in wartime can

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be controlled by stabilizing wage rates. . . The basic problems arising from an excess of purchasing power in wartime can only be handled through taxing and saving programs. It should also be noted that the so-called inflationary gap—the excess of purchasing power over the supply of civilian goods—has not resulted in any pell-mell rush to buy goods. . . the American people (have) not attempted to spend their income in a period when civilian goods were scarce. Instead, with confidence in the country's stabilizing controls, they have saved approximately 25 percent of their income after taxes. The American people are willing to put their money into war bonds and savings, because they believe their dollars will be worth as much in the future as they are today. Wage stabilization does have an effect upon the problem of excess purchasing power. But adjustments to eliminate wage inequities have far less effect than some people seem to think.

Wage stabilization has a direct effect upon the manpower problem. Unrestricted bidding by employers for scarce labor in wartime could have created a chaotic manpower situation. Employees themselves would be induced to go "job shopping," migrating from plant to plant in quest of higher pay. You can imagine the effect of such a manpower condition upon n industrial machine striving for maximum war production. . .

Controlling Prices

Another reason for stabilizing wages is to help control prices. Prices cannot be held in line if higher wages cause increased costs to such an extent that prices have to go up. Wage increases which push up production costs may come home to roost with the wage earner—in the form of higher prices. If he asks for another wage increase, on the strength of the higher prices—then we're off again on the inflationary merry-go-round. . .

There you have the "why" of wage stabilization. As to the "how" of the picture, let me describe the rules which implement wage stabilization in America. . . The problem of wage stabilization is a problem of bringing a series of wage movements under control. If I could draw a simile, I think you could more easily understand the nature of the problem.

The basic movement of wages might be compared to a groundswell in the ocean—an underlying movement which has a general effect. Then there are cross-currents which run at any tide level. In wages, these cross-currents are the differences in wage rates between Plant A and Plant B, which are present no matter what the general level of wages. And finally there are the surface movements, which you find in any large body of water. These are the differences in wage rates paid for similar work within a single plant.

Let me describe first the groundswell in the general level of wages. Some of you have experienced those movements. In 1937, for instance, a few companies gave a 10-cent-an-hour wage increase, and all their competitors felt compelled to

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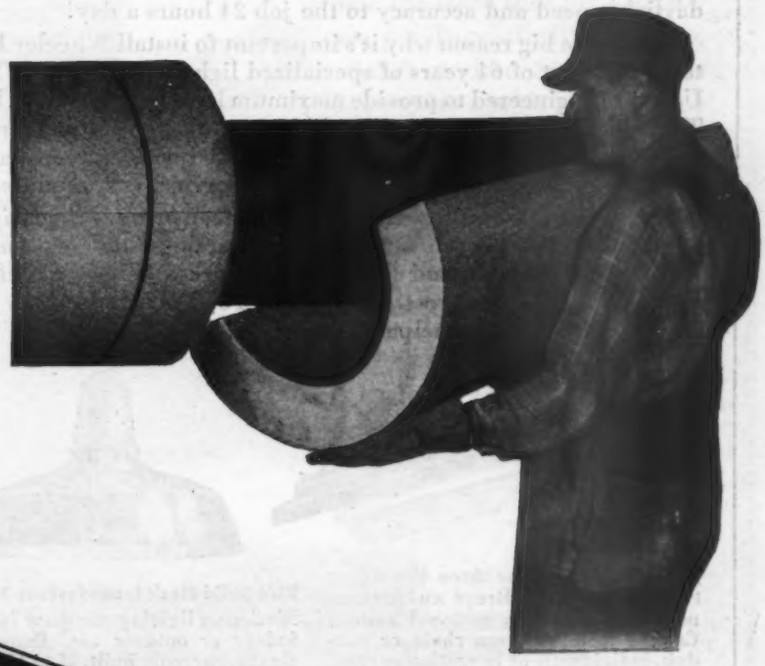
Unibestos is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5". Single layer construction is available for service up to 1200°.



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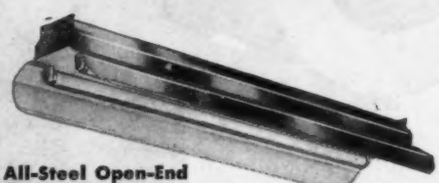

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give a general 10-cent increase, too. A groundswell movement was started and it ended by raising the general level of wages.

Such general movements are the most difficult to bring under control because they develop in response to changes in basic conditions, such as movements in the cost of living or a tight labor market.

The Little Steel formula is designed to bring such groundswells under control. . . To check an inflationary movement the government had arbitrarily put a lid on a dynamic situation. The War Labor Board in its Little Steel formula said, "Those workers who were lagging most in the upswing of wages should be brought up with the majority before you say stop." The Little Steel formula provided an exception to the rule of no more general wage increases.

That was the original effect of the Little Steel formula, to assure lagging groups of workers of at least a 15 percent increase. Today virtually all of the Little Steel increases have been given in manufacturing industries and the effect of the formula is to impose a ceiling on general increases. That has led to strenuous efforts to revise the formula.

But let me point out—the request to change the Little Steel formula today is really a request for a wage increase for virtually 100 percent of American labor in manufacturing industries. . .

General wage increases may possibly return to the economic picture while governmental controls are retained, as growing availability of manpower and civilian goods relieves the inflationary pressures which originally caused the government to restrict general wage adjustments to limitations of the Little Steel formula.

Wage Cross-Currents

The Little Steel formula, then, is the War Labor Board's method of dealing with a wartime groundswell in the general level of wages. Next there are the cross-currents, which will be found at any tide level. If tomorrow every wage-earner in America should get a nickel-an-hour increase, the problem of whether rates at Plant A were out of line with rates at Plant B would not be solved at all. Whatever the general level of wages, the problem of variation in rates between plants in the same labor market area would still persist. . .

In every community there are historical differences in the rates paid for similar work. Some of these differentials are reasonable and normal variations in the wage rates of the area even in wartime. The War Labor Board has had to develop a procedure for determining what differences are abnormal in an area. . . I anticipate that one of the great reconversion jobs will be to convert those area wage relationships to industry-cost relationships. And I don't mean industry-wide equalization. In a loose labor market, management's chief concern will be not with whether a wage rate will get manpower in the local labor market, but whether it permits production costs in New York

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So much for cross-currents in wages. There remain the surface movements which concern the relationship of Job A to Job B in the same plant. . . One of the most striking impressions I have of American wage rate structures is the failure of a large part of industry to develop properly aligned wage schedules in the plants—with jobs defined, rates standard for those classifications, and rates for particular jobs compensating with reasonable accuracy for the skill involved.

Too many wage scales have what I call "random rates" based not on the job but on the individual. I think a great task before a large part of American industry—certainly the mass production industries—is to work out rational wage structures which provide a definite rate structure for definite jobs.

And the time to start on that task is now, so that when we come to reconversion, we shall not be setting wages on what appears to be a capricious or personal basis.

•

The Economies of the Annual Wage

EMERSON P. SCHMIDT, Director, Economic Research Department, Chamber of Commerce of the United States, before the American Management Association Personnel Conference

In the recent attack in the steel case on the Little Steel wage formula, the labor union involved made as one of its primary demands an annual wage, asserting with vigor and confidence that the annual wage, even in the steel industry, is practical and workable.

A number of employers, by voluntarily adopting annual wage plans, have placed their stamp of approval upon the idea, at least for their own plants, although some of them have crusaded for the idea generally. Most employers who have examined the proposals have been skeptical.

Who is right—the Social Security Board, which says "the causes of most unemployment are beyond the control of individual employers or industries," and the majority of employers, or the labor union and the minority of employers? When extreme but conflicting claims are advanced, the truth often lies somewhere between . . .

If employers generally adopted annual wage plans and thereby maintained consumer spending, the tendency, we are told, toward stagnation and over-saving would be offset.

Is this new orientation correct, and does it justify a new look at the annual wage idea? . . .

The notion that unemployment is due to deficiency of income and general spending finds little or no support among economists. Even Karl Marx, the founder of "scientific" socialism, remarked that depressions come when wage income is at a peak. He might have added that when consumer or wage income is at a

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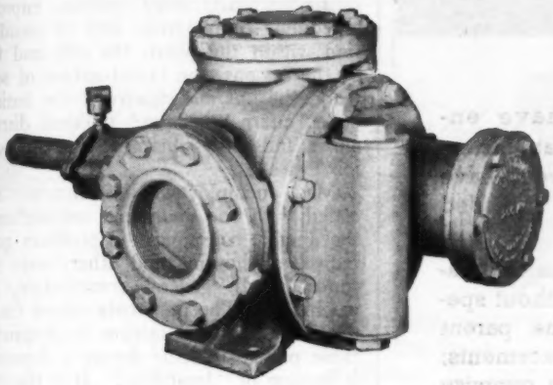

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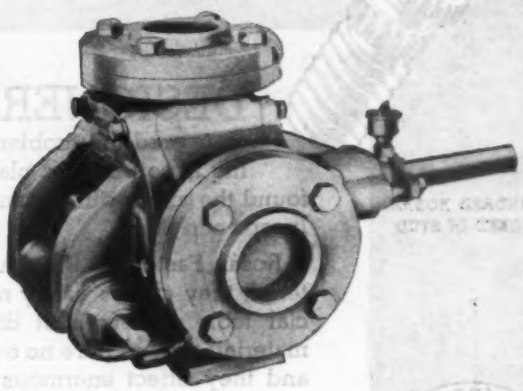

TRI-ROTOR Pumps are used successfully in transferring high viscosity materials such as—molasses, glue, etc.

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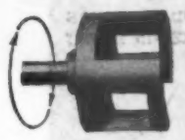
Smoother pumping... more economical pumping... are what you get with Yale & Towne's Tri-Rotor Pump. This low pressure positive displacement pump gives highest volumetric efficiency when handling either thin or viscous liquid. These pumps do not chew, foam, heat or aerate the material being handled. Sizes from 5GPM to 200GPM.

Only 3 moving parts — minimum maintenance — low operating cost.

These exclusive features are optional and interchangeable: Variable Volume Control, Manual Flow Control, Integral Relief Valve or Solid Head.



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A SHUTTLE

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A locking ring, serrated inside and out, engages its inner teeth with a serrated collar on the Rosán Insert or Stud. The outer teeth of the locking ring broach their way into the parent material at the surface of a counterbore when driven or pressed into place. This makes the insert or stud an integral part of the parent material and completely permanent.

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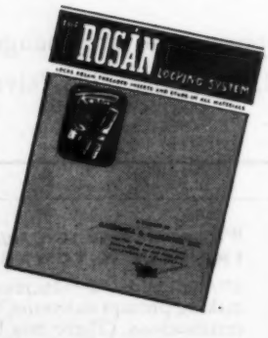
Rosán Locked-in Inserts and Locked-in Studs are the solution to innumerable fastening problems in all types of industry. New applications for these fastening units are being developed by our engineers and by our clients regularly. Manufacturers are invited to submit their problems.

Write for free literature on the Rosán Locking System.



U. S. and Foreign Pats. Pend.

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6

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BARDWELL & McALISTER, INC.

EXCLUSIVE LICENSEE

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all-time low, at the bottom of a depression, then we begin recovery. This does not give much support to the new philosophy that annual guaranteed wages would insulate us against depression and unemployment in a voluntary society. . .

Although unemployment always means wage losses to the worker, its causes are innumerable. The introduction of labor-saving machinery, wage rigidities, improper scheduling of materials, lack of coordination within the plant, the ebb and flow of the seasons, the casual nature of some work, the ups and downs of the business cycle, international and political disturbances, and others, may be associated with job losses. . .

Mass unemployment is commonly associated with the enormous contraction in the durable consumer and producer goods industries—housing and other heavy consumer goods, general construction, and machinery. The proximate reason for the relatively great contraction in demand in these particular fields during a depression is because of "durability." It is the durability of these goods that makes replacement postponable because the existing house, stove, plant, or machine can be made to suffice for the time being.

One of the most compelling reasons against forcing annual wage plans upon management, either by group action or by government order, are these varying shifts in demand. A dynamic and free society is one of constant change and adaptation. Compulsion would tend to freeze the economy and would soon destroy the spirit of risk-taking and venture, and probably would have to end up with dictation to the consumer.

Careful Study Needed

Many things are to be said in favor of the annual wage. But no company should accept such a commitment without careful study. Basically, an annual wage which provides a regular pay check every week makes the standard wage the minimum wage, and this standard wage must be paid for a whole year. If, at the end of the year, a smaller commitment, or one less favorable to the worker, is advanced because the commitment threatens the solvency of the enterprise, this will be resented and, instead of improving industrial relations and adding to the security of the worker, it may have demoralizing effects. If a beginning is to be made, it should not be on too ambitious a scale. Its coverage and scope, if partial, must appeal to the reasonable man as being fair. It should not be so extensive that it destroys the spirit of enterprise and expansion of management. It should be entered into voluntarily by the management, and not merely to get out of a tight squeeze in the process of collective bargaining. The plan should be fully explained to the workers at all stages. Better still, the workers should be consulted all along; otherwise suspicion and resentment may develop.

If the workers secure some definite advantages under the plan, they frequently are willing to furnish a *quid pro quo* in

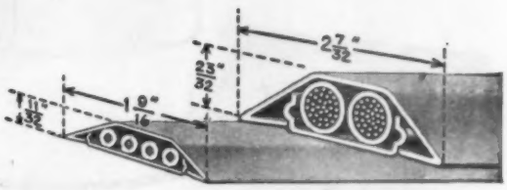
"We'll have to move this department to the floor above"

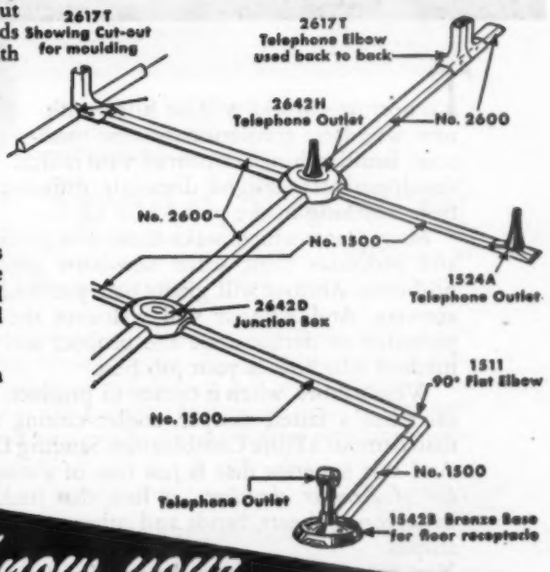
When this happens . . . as it does every day in busy office buildings . . . will there be costly delays and confusion in re-connecting telephone, communications, and light and power services to desks? Not if you install "Pancake" . . . the Wiremold Overfloor Wiring Systems designed for just this purpose.

PANCAKE SOLVES THE WIRING PROBLEM

PANCAKE

"Pancake" Overfloor Wiring Systems . . . "flat as a pancake; strong as a bridge" . . . are available in two sizes, No. 1500 with a capacity of 4 No. 12 and No. 2600 with a capacity of 2 26-pair telephone cables. Together, these two sizes of raceway and their fittings permit complete, efficient, and speedy layout of wiring for all telephone or power and light service needs in offices. Later additions, extensions, changes are made with time- and cost-saving facility.





AND HERE IS HOW IT IS DONE

1524 Telephone Outlet

Base of "Pancake" Raceways provided with screw knockouts for easy installation. Slip-joint connections to fittings insure electrical bonding. Wiring is laid in and cover sections snapped on to complete installation. Raceways and Fittings are designed to meet telephone company requirements.

Write us today for bulletins describing installation and use in detail. The Wiremold Company, Hartford 10, Conn.

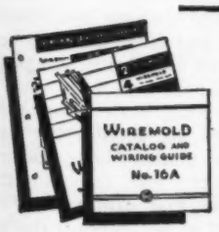
1542B Receptacle Base

1542D Junction Box

2642D Junction Box

2642H Telephone Outlet

2617T Telephone Elbow



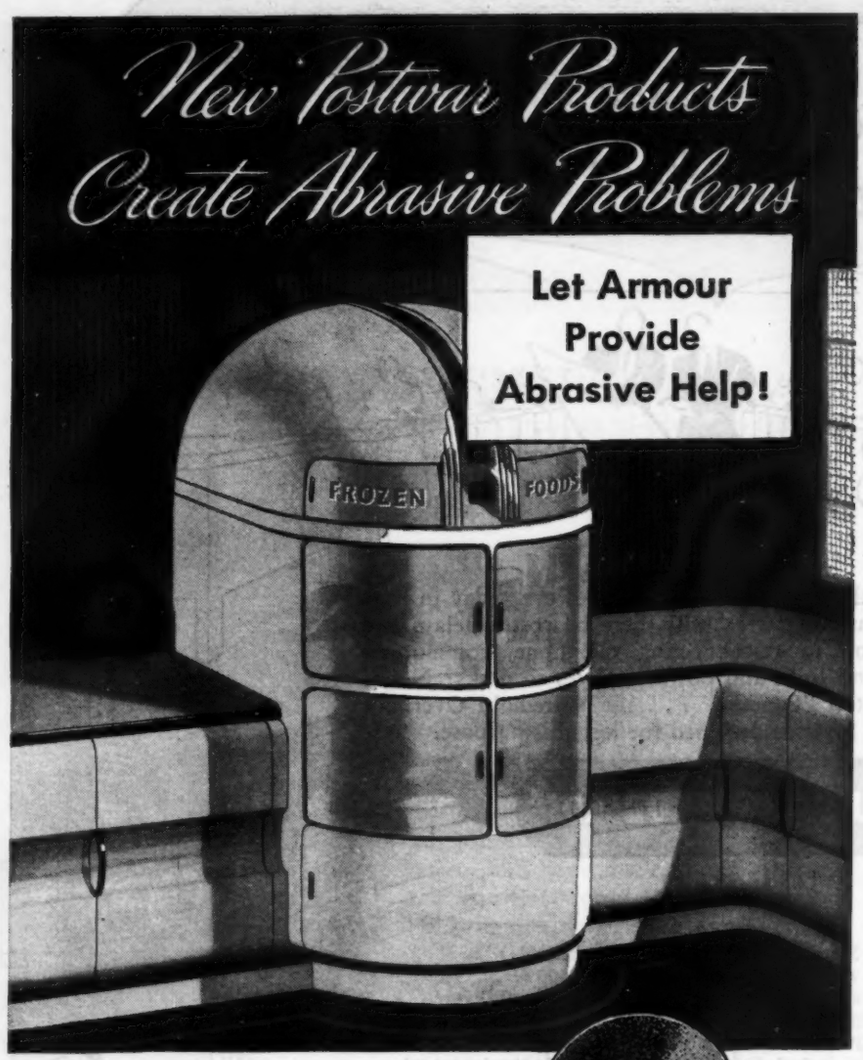
PRODUCTION EXECUTIVES

There are many unusual ways in which Wiremold can help you save motions, speed production and assembly through efficient "wiring for work". Write us for Wiring Guide, industrial bulletins and data sheets.

Know your WIREMOLD

NEMA

BUSINESS BUILDER IN TOMORROW'S MARKET FOR ADEQUATE WIRING



Tomorrow's world will be filled with new wonders: revolutionary new products; familiar things improved with radical developments; designs distinctly different from anything in the past.

Many plants which make these new products and processes must solve new-born abrasive problems. Armour will gladly help you find the answers. And Armour will welcome the opportunity to demonstrate the product and the method which does your job best.

What's more, when it comes to product, you can't buy a faster, sharper, cooler-cutting tool than Armour's Fibre Combination Sanding Disc. And this superior disc is just one of *a complete line of Armour abrasives*...a line that includes belts, cones, sheets, bands and other specialized shapes.

Yes, great things are in the making for postwar. But until final Victory, industry's chief aim remains getting the weapons of war to our fighting men.

For practical abrasive advice, write or call

Armour Sandpaper Works

DIVISION OF ARMOUR AND COMPANY
1355 West 31st Street, Chicago 9, Illinois

the way of reducing restrictive practices and rules. The employees should have their understanding deepened of the fact that the management's sustained wage-paying capacity depends upon the customers and the solvency of the enterprise, and not upon the size of the boss's pocketbook or bank account.

•

Should Management Be Unionized?

A statement by General Motors Corporation, Detroit

The National Labor Relations Board has ordered a bargaining election among the foremen and other supervisory groups of a Detroit automobile company.

This company is not a part of General Motors, but we are concerned with the principles involved.

This confusing action by the board means that it is sanctioning and promoting the unionization of management personnel, in spite of the fact that the National Labor Relations Act includes as an employer ". . . . any person acting in the interests of an employer directly or indirectly."

We are sure that Congress did not intend to approve unionization of management when it passed the Act.

The results, if applied throughout industry, would be bad for the management groups involved, bad for industry, bad for labor, bad for America.

We think it would be bad for foremen if American industry should be compelled to make a change in its proved type of organization, which would unavoidably reduce the foreman's status, diminish his responsibility, authority, and influence, decrease his opportunities for personal advancement.

In General Motors, foremen have always had important responsibilities and authority.

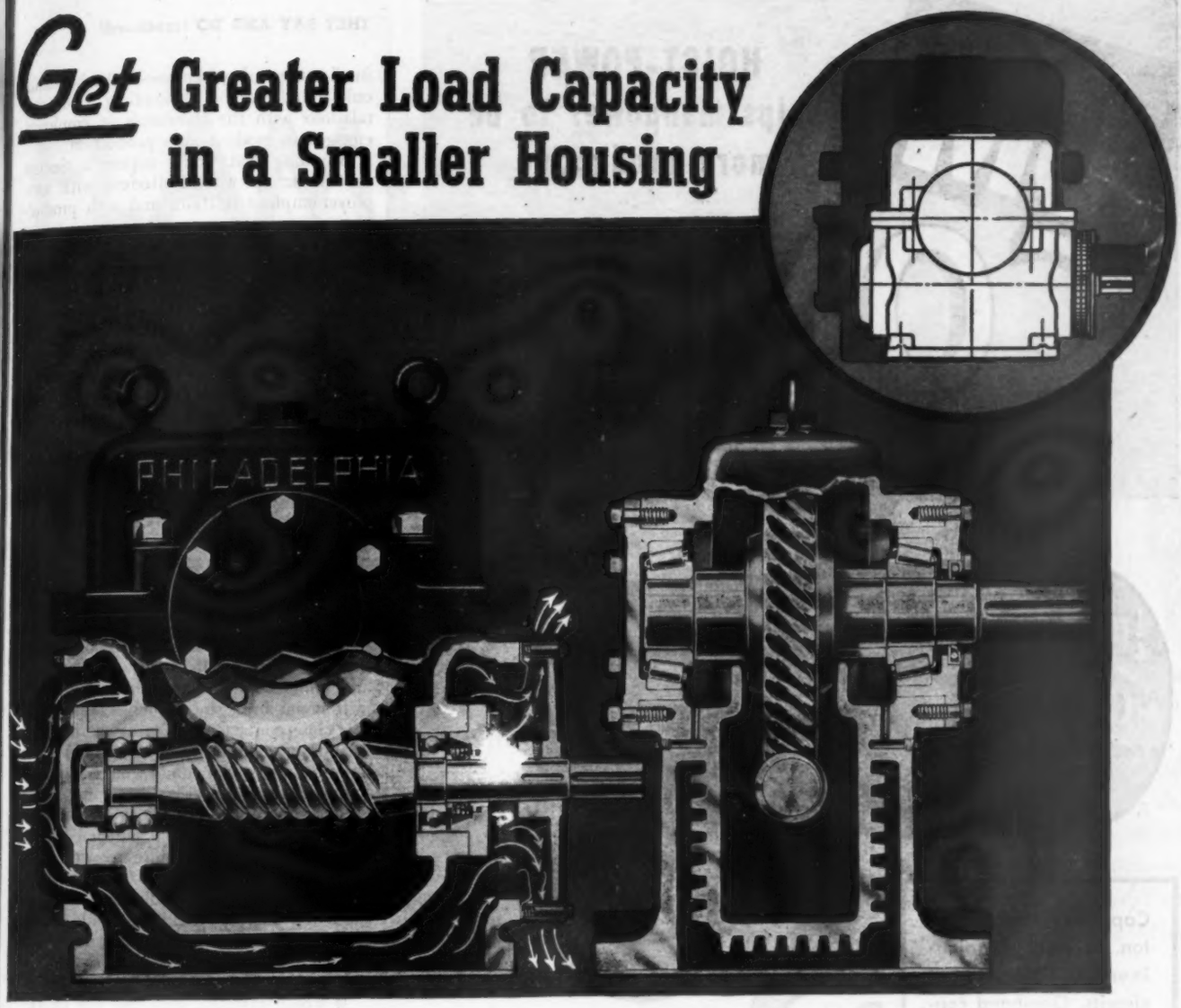
We have always guarded the status of our foremen, and have provided special training to improve their abilities, increase their efficiency, and enhance their opportunities for promotion to even more important management positions. The great majority of General Motors's principal executives at one time were foremen.

We are convinced that it would be impossible for a foreman to follow both management and union leaderships at the same time, and under those conditions to carry on all his duties as they now exist. All elements of management must have a common objective.

It would obviously be impossible, for instance, for him as a fellow unionist with those under him, to perform his functions which relate to their working conditions, wages, promotions, and assignments on the unbiased basis which is essential to good management.

From our experience, both before and during the war, we are certain that the accepted American method of spreading managerial authority and responsibility among foremen—so that management is in close, direct contact with comparatively

Get Greater Load Capacity in a Smaller Housing



...with the Philadelphia AIR KOOLED Worm Gear Speed Reducer

At the upper right is shown the comparative sizes of a size 675 Type AT standard unit (in blue) and a size 475 AirKooled unit. Both deliver 20 HP at 1750 RPM. Ratio 4 6/7 to 1.

The cut-away drawings show the double-walled, finned housing and the flow of air around the oil reservoir.

Considerable *space* and *weight* savings have been made possible by the design of Philadelphia AirKooled Worm Gear Reducers as compared with standard heavy duty type worm gear units.

The AirKooled design features a suction fan, mounted on the worm shaft, which draws air through the double-walled, finned housing. This dissipates generated heat, and thereby maintains a higher contact oil film strength and greatly increases the horsepower ratings at worm speeds of 580 and 1750 RPM. For all ratios at 1750 RPM the ratings are approximately doubled, so the AirKooled unit is about two sizes smaller than a standard unit of the same capacity.

Let us tell you what these savings can mean to you.

SEND FOR BULLETIN 250 .... *on your Business Letterhead*

Philadelphia GEAR WORKS INCORPORATED

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

CM COMET

HOIST-POWER helps manpower to be more productive

Capacities from ⅛th to 1 ton. Available for plug-in on 110, 220 or 440 volt circuits. One-hand control. Prices from $130.

Materials handling is said to represent the largest single labor cost in industry—the largest single use of manpower. CM Comet Electric Hoists can make this same man (and woman) power more productive, more efficient and with less fatigue. From "receiving", through the production line, to "shipping", CM Comets are doing an outstanding job in making both ends meet. Write today for CM Bulletin 138 for entire illustrated details.

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HOIST CORPORATION
(Affiliated with Columbus-McKinnon Chain Corporation)
GENERAL OFFICES AND FACTORIES: 130 Fremont Ave., TONAWANDA, N. Y.
SALES OFFICES: New York, Chicago and Cleveland

small groups of workmen—is the best and only sound method of handling day-to-day relations with the thousands of employes engaged in modern mass production.

Anything that would require a change in this set-up would interfere with employer-employe relations and with production.

For example, there have been many strikes in war production plants, particularly in Michigan. Charges have been made that workmen have been loafing in plants engaged in war production, and that they are being paid high wages for not working. We are conscious that the public feels that there must be something wrong. The attempts to tear down the position and authority of foremen and to unionize members of management is importantly contributing to this condition.

As a matter of fact, the close-contact method is about the only way that management and labor can work harmoniously together in large organizations.

Much is said these days about cooperation. It would be a serious handicap to any hopes for teamwork and the pursuit of common interests, if anything were done to remove this facility for knowing and understanding each other.

It is our firm, sincere belief that loss of this close contact would make harmonious relations between management and labor almost impossible, and would interfere with *practical* collective bargaining.

The removal of foremen from their present position as a vital, integral part of management would require reorganization of factory management on a basis far more complicated and decidedly less effective. Necessary factory discipline would suffer, worker efficiency would be impaired.

We believe the effect on you—on the public as a whole—would be very real.

It would interfere with the war effort.

It would make war materials cost more.

It would slow up post-war reconversion to civilian production.

It would delay adequate post-war output of cars, refrigerators, ranges, furniture—all the things people need so much and have waited for so long.

Finally—and, in the long run, perhaps most important of all—it would so increase production costs as to boost prices and the cost of living, and make the problem of reasonably full employment much more difficult.

When people have as deep a conviction about anything as we have about unionizing management, they ought to do something about it.

If the meaning of the National Labor Relations Act can be so confused as to promote unionization of management—and thus impair the effectiveness of the American production system of which we are all so proud—then the meaning ought to be cleared up.

General Motors believes—and hopes others will feel the same—that it is a patriotic duty, a duty to the foremen, to industry, to labor, and to the public as a whole—to oppose the unionization of management by every proper and lawful means.

That is our intention.

FLAMENOL* CORDS

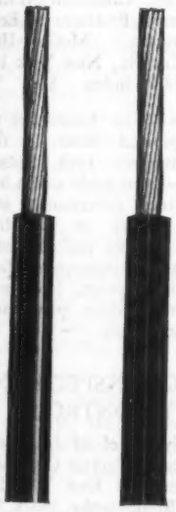
(Thermo-plastic Insulation and Jacket)

For Industrial Use

Here's the ideal heavy-duty cord to use on portable tools for utility maintenance work. It is ideal also for use on tools in industrial plants, machine shops, mines, service stations, garages, packing houses, etc. It is available with two or three conductors.

This Flamenol Cord is mechanically strong, easy to handle, light in weight and flexible. Both the insulation and jacket of the cord are made of long-life, thermo-plastic compounds. These compounds are resistant to water, oils, acids, alkalies and sunlight.

The same physical and electrical tests made on Flamenol Building Wire are made on this cord. In addition, special tests are made which simulate tough working conditions. Flamenol Cord can be depended upon, without question, for trouble-free service under severe operating conditions.



Type SN for general purpose wiring

Type SNW for wiring in wet locations

FLAMENOL BUILDING WIRE

Flamenol small diameter, thermo-plastic building wire is ideal for new wiring, rewiring and maintenance wiring. Flamenol wire is particularly ideal for rewiring because its small diameter permits more copper to be placed in conduits. It is available in sizes 14 to 2,000,000 CM, and can be used for feeders, branch circuits or special wiring.

*Reg. U.S. Pat. Off.

FOR FURTHER INFORMATION on Flamenol Portable Cords or Flamenol Building Wire, see the nearest G-E Merchandise Distributor or mail the coupon.

General Electric Co.
Section W552-37
Appliance and Merchandise Dept.
Bridgeport, Conn.

Sirs: Please send me information on

☐ Flamenol Cords ☐ Flamenol Building Wire

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BUY WAR BONDS AND HOLD THEM

GENERAL ELECTRIC

DON'T LET VIBRATION IMPAIR YOUR EMPLOYEES' HEALTH AND EFFICIENCY; INSTALL . . . . KORFUND VIBRATION CONTROL

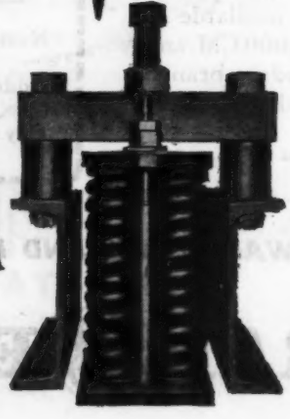
Vibration and its ever-present partner, noise, have been proven by scientific study to have a serious effect on the health and efficiency of industrial workers. Nervous ills, headache, deafness and excessive fatigue, resulting in higher accident rates, can be caused by uncontrolled vibration. Vibration and noise from drop hammers, punch presses, and other impact machines are among the causes of absenteeism in industry.

An industrial plant in which adequate vibration control equipment has been installed under the direction of Korfund engineers is a safer, healthier place to work. Increased employee good will and efficiency as well as lower industrial insurance premiums are the results.

Why not investigate the many advantages of Korfund Vibration Control? Descriptive literature will be sent on request.

THE KORFUND COMPANY, INC.
48-25 Thirty-second Place, Long Island City 1, N. Y.
Representatives in principal cities.

KORFUND VIBRATION CONTROL



Above—Drop hammer foundations during installation of Korfund Isolators.
***Right*—Typical Korfund Steel Spring Isolator.**

BOOKS

UNION POLICY AND INCENTIVE WAGE METHODS

Van Dusen Kennedy, Head, Automotive Staff, Regional War Labor Board, Detroit. Columbia University Press, New York. 260 pages. Bibliography, index. $3.

Management believes that volume production at low cost calls for incentive wage plans and scientific methods; labor often finds these methods at odds with its own ideas of wages and security. Book includes case studies of collective bargaining relations in a number of industries, and throws light on the relationship between unionism and industrial efficiency. In six chapters: "Introduction"; "Incentive Wage Systems and Time Study Methods"; "Union Attitudes and General Policies"; "Union Policies: Restriction and Aspects of the War Period"; "Extent and Nature of Union Participation"; "Union Agreement Provisions."

PROBLEMS OF THE POSTWAR WORLD

Edited by Thomas C. T. McCormick, Chairman of the Department of Sociology and Anthropology, University of Wisconsin. McGraw-Hill Book Co., 330 West 42nd St., New York 18. 526 pages. Tables, index. $3.75.

Collection of 20 papers written by specialists in their field, dealing with domestic, governmental, and international post-war problems. Topics include labor unionism; further development of social security legislation; agricultural production and prices; post-war taxes; Negroes; relations of government to business and governmental planning; foreign economic policy; a world organization to prevent war; and how to deal with a defeated enemy.

ORGANIZED LABOR

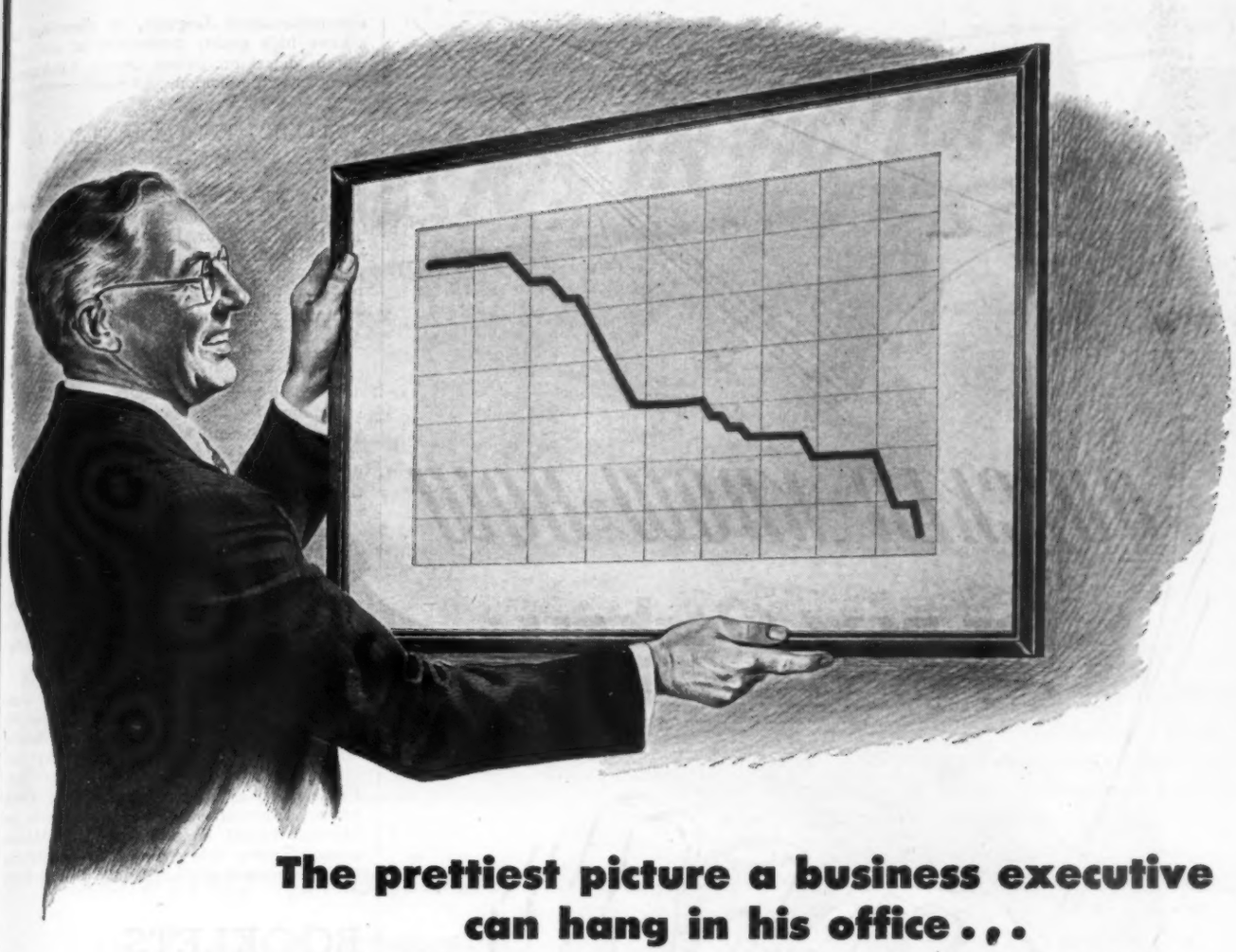
Harry A. Millis, Professor and Chairman Emeritus of the Department of Economics, The University of Chicago, Chairman NLRB, and Royal E. Montgomery, Professor of Economics, Cornell University. McGraw-Hill Book Co., 330 West 42nd St., New York 18. 930 pages. Charts, tables, index. $6.

Volume III in series "The Economics of Labor." Analyzes organized labor in the United States and discusses 19th century American unionism; American trade union history; trade union structure, government, and interrelationships; the theory of collective bargaining; trade union policies and methods; the problem of strikes and lockouts; conciliation and arbitration of labor disputes; labor and politics, employee representation plans and independent unions; and so on.

MANAGEMENT OF INSPECTION AND QUALITY CONTROL

J. M. Juran, formerly Chief of Inspection Control Division, Western Electric Company, Inc. Harper & Brothers, 49 East 33rd St., New York. 233 pages. Bibliography, index, $3.

Book is directed at those who must meet the challenge of greater precision for more product; at plant executives to demonstrate the existence of the inspection function; at shop supervisors to show how the inspection function relates to the plant generally; and, finally, at the members of a new profession—inspection engineering—to expound the engineering problems inherent in inspection and quality control. Written in non-technical,



The prettiest picture a business executive can hang in his office . . .

(If he wants to strengthen the position of his company in the competitive period ahead.)

A CHART with the curve taking a power dive? *That* should make an executive happy?

It should. It does. And it will . . . increasingly . . . in the competitive period ahead. For this curve is a curve of non-productive *costs*. The costs which can strengthen or weaken your position in your industry. The costs which can broaden or narrow the market for your product . . . make it do its part, or *fail* to do it, in helping turn America's *wanting* power into buying power *to maintain employment and a high level of national income.*

Where can you look for cost reduction?

Technical advances in manufacturing methods . . . further streamlining of factory production? No doubt. But management with vision is looking to another and *almost untapped* source of savings!

Where is it? In the best possible hiding place. In written systems of control. In paper-work procedures that have grown up by improvisation and temporary expedience. In writing methods whose only excuse is, "We've always done it this way." In form designs that waste time, hide facts.

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When you get into written systems of control, you find that the *direct* savings that can be effected . . . in the cost of *finished records* . . . are, in themselves, substantial. But more important, these savings multiply themselves throughout your office and factory. For written pieces of paper start, stop and control every business operation. They can permit waste—or prevent it.

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LAMINUM
THE SOLID SHIM THAT peels FOR ADJUSTMENT

non-mathematical language, to show how to achieve high quality production at minimum cost by defect prevention, quality mindedness, smooth flow production, and quality reputation.

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Wendell H. Cornetet, Assistant Coordinator and Head of Vocational Science Department, and Daniel W. Fox, Head of Physics Department, Huntington East High School, Huntington, W. Va. McKnight & McKnight, Bloomington, Ill., 323 pages. Drawings, photographs, tables, figures, index, $2.50.

One of a series of books prepared to provide courses in practical science and mathematics—designed to give the necessary preliminaries or background for the specialized occupations required in present-day industrial plants. In addition to instruction concerning procedure, each assignment is supplemented with information units and report or tests.

HEATING, VENTILATING, AIR CONDITIONING GUIDE, 1945

The American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10. 1216 pages. Photographs, drawings, tables, indexes. $5.

Contains 48 chapters of technical data and information grouped under the general subdivisions of Principles; Heating and Cooling Load Calculations; Combustion and Consumption of Fuels; Steam and Hot Water Heating; Air Heating, Cooling, and Conditioning; Automatic Controls, Instruments, and Motors; Special Applications; and Miscellaneous. Catalog data section contains information on products of 212 leading manufacturers.

BOOKLETS

SICKNESS INDEMNIFICATION. A panel discussion by R. A. Hohaus, Associate Actuary, Metropolitan Life Insurance Co.; Andrew T. Court, Labor Economics Section, General Motors Corp.; W. M. Gafafer, Chief, Statistical Unit, Hygiene Division, Bureau of State Services, U. S. Public Health Service; Nathan Sinai, Professor of Public Health, University of Michigan. Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13. 55 pages. Figures, charts, references. 50c.

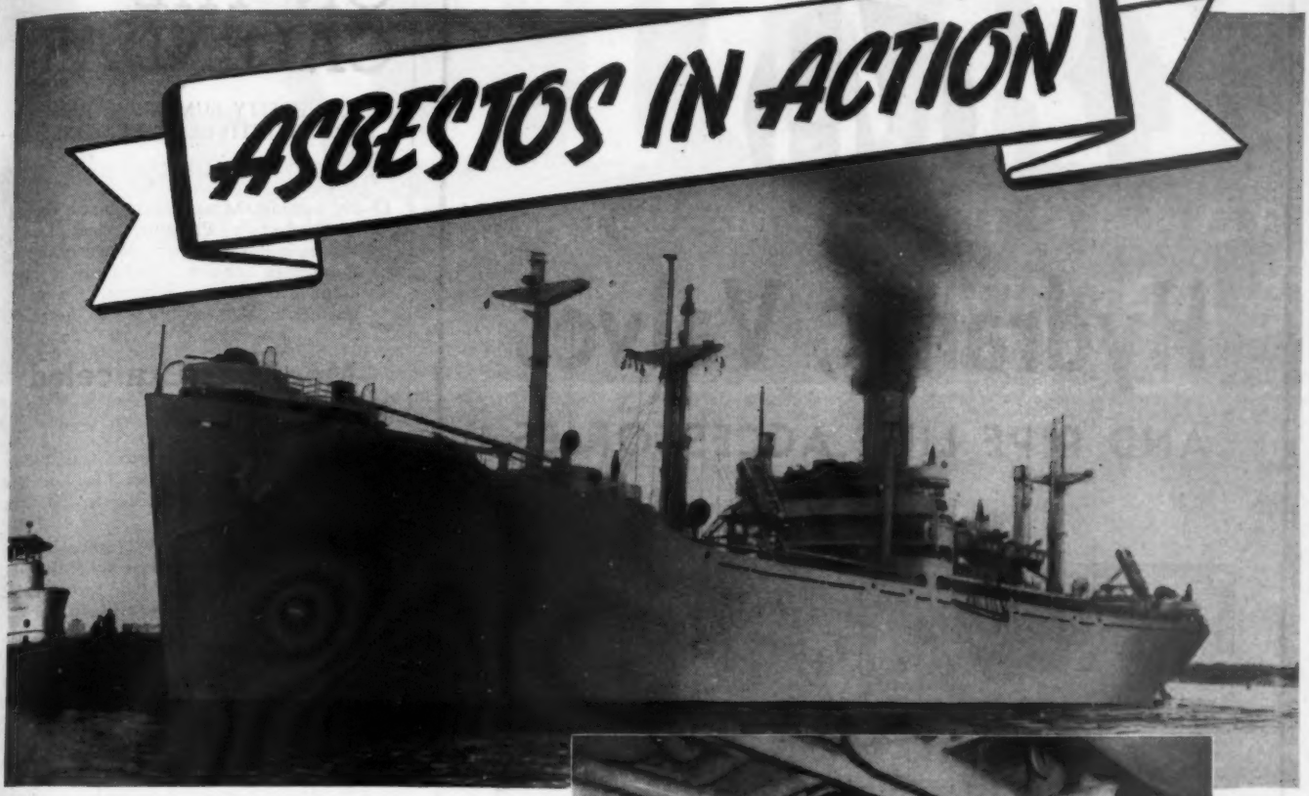
IMPROVEMENT OF LABOR-UTILIZATION PROCEDURES. Bulletin No. 807. U. S. Department of Labor, Bureau of Labor Statisics. 44 pages. Tables. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 10c.

COUNSELING IN PERSONNEL WORK, 1940-1944. A bibliography compiled by Paul S. Burnham, Assistant Professor of Psychology and Associate Director, Department of Personnel Study, Yale University. Public Administration Service, 1313 East 60th St., Chicago. 38 pages. $1.

LUMBER AFTER THE WAR—How Good, How Much, How Long? S. R. Black, Vice-President, Weyerhaeuser Sales Co., St. Paul. American Forest Products Industries, Inc., 1319 18th St., N.W., Washington D. C. 20 pages, pocket size. Drawings. No charge.

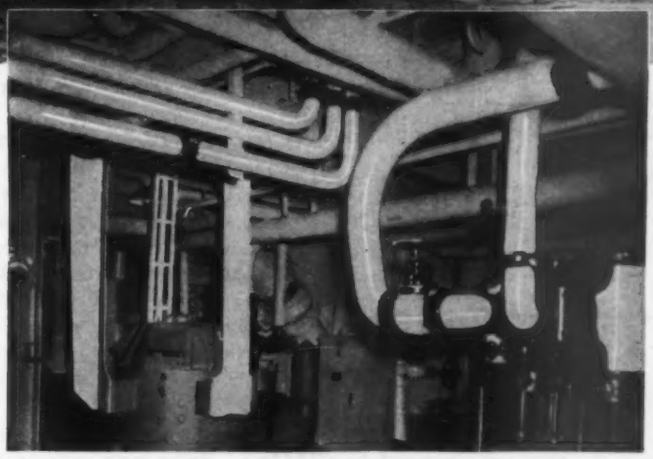
EXHAUST HOODS. How to design for efficient removal of dust, fumes, vapors, and gases, with data formulas, and practical examples showing exact procedures. J. M. Dalla Valle. *Heating and Ventilating*, 148 Lafayette St., New York 13. 49 pages. $1.

ASBESTOS IN ACTION



Saving precious fuel and steam

K&M "FEATHERWEIGHT" 85% *Magnesia*



"Photo Courtesy Armstrong Cork Company"

Every intricate bend of the steam piping to pumps and apparatus in the engine room of this cargo vessel is tailored uniformly with K&M "Featherweight" 85% Magnesia. This widely used pipe covering combines the high insulating properties of basic Carbonate of Magnesia with strong Asbestos Fibres, and is designed for pipes carrying temperatures up to 600° F. It is extremely light in weight and it delivers maximum efficiency.

In one shipyard alone, 250 cargo vessels of the Liberty and faster 16 knot Victory type (pictured above) have been insulated by the skilled coverers of the Armstrong Cork Company, distributors of K&M "Featherweight" 85% Magnesia.

K&M "Featherweight" 85% Magnesia is giving this same kind of dependable service—these same heat and fuel savings—in power plants and industrial process plants all over the country. In fact, from the time 85% Magnesia Insulation was first developed by K&M more than sixty-five years ago, the name "Featherweight" has been a byword for quality with plant operating men.

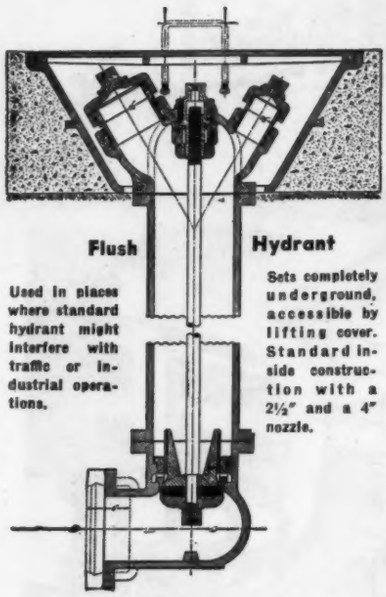
YOUR MERCHANT MARINE SAVED US DURING WAR—LET IT SERVE YOU DURING PEACE

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

Hydrants, Valves

AND PIPE LINE ACCESSORIES



Flush

Used in places where standard hydrant might interfere with traffic or industrial operations.

Hydrant

Sets completely underground, accessible by lifting cover. Standard inside construction with a 2½" and a 4" nozzle.

Write for Catalog No. 34

CHECK VALVE

GATE VALVE

M & H valves are used in industrial plants for water, gas, steam, oil, chemicals and are furnished in all commercial sizes from 2" to 30", inclusive. They are cast iron body, bronze mounted, furnished double disc parallel seat or solid wedge. They are heavily proportioned and have a high factor of safety.

M. & H. STANDARD FIRE HYDRANTS are revolving head, dry top, bronze mounted. They are approved by "UA&FM". Entire main valve assembly is removable through barrel without digging. Special Traffic Model is fitted with breakable bolts and stem coupling, designed to break at ground line under impact. Repairs are made simply by renewing bolts and coupling, without shutting off the water.

M & H PRODUCTS INCLUDE

FIRE HYDRANTS
GATE VALVES
TAPPING VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

WRITE FOR PRICES

M & H VALVE

AND FITTINGS COMPANY

ANNISTON, ALABAMA

ON THE CALENDAR

UNIVERSITY SUMMER COURSES FOR EXECUTIVES AND ENGINEERS

JUNE

11–29, Summer Management Course devoted to Production Planning, Plant Layout, Motion and Time Study, Wage Incentives, and related subjects. University of Iowa. Ralph M. Barnes, Director, College of Engineering, University of Iowa, Iowa City.

Meetings Canceled

MAY

American Management Association, Packaging Conference, scheduled for May 3-4, New York. James O. Rice, Manager, 330 West 42nd St., New York.

National Association of Suggestion Systems, Spring Conference, scheduled for May 9-10, Detroit. H. F. Foley, Executive Secretary, 122 South Michigan Ave., Chicago.

American Management Association, Production Conference, scheduled for May 15-16, Cleveland. James O. Rice, Manager, 330 West 42nd St., New York.

American Leather Belting Association, National Meeting, New York. E. R. Rath, Executive Vice-President, 53 Park Row, New York.

Chamber of Commerce of the United States, Annual Meeting, New York. Ralph Bradford, General Manager, 1615 H St., N. W., Washington, D. C.

National Fire Protection Association, Annual Convention, Philadelphia. George W. Elliott, Secretary, 1129 Walnut St., Philadelphia.

JUNE

American Society of Refrigerating Engineers, Spring Meeting, scheduled for June 11-13, Milwaukee. A. B. Stickney, President, 50 West 40th St., New York.

National Association of Cost Accountants, Annual Meeting, scheduled for June 23-27, New York. W. P. Fiske, Secretary, 385 Madison Ave., New York.

American Institute of Electrical Engineers, National Technical Meeting, scheduled for June 25-29, Detroit. G. S. Rich, Technical Progress Committee, 33 West 39th St., New York.

American Society of Heating and Ventilating Engineers, Semi-Annual Meeting. A. V. Hutchinson, Secretary, 51 Madison Ave., New York.

American Society of Mechanical Engineers, Semi-Annual Meeting. Ernest Hartford, Executive Assistant Secretary, 29 West 39th St., New York.

American Society for Testing Materials, Annual Meeting, scheduled for June. Robert J. Painter, Assistant to the Secretary, 260 South Broad St., Philadelphia.

Society for the Promotion of Engineering Education, Convention, scheduled for June, St. Louis. Frank E. Wheeler, Director of News Bureau, Illinois Institute of Technology, Chicago.

JULY

Silver Bay Conference on Industrial Relations, 28th Annual Conference, scheduled for July 25-28, Silver Bay-on-Lake George, N. Y. Earl M. Dinger, Secretary, 347 Madison Ave., New York.